MANUFACTURERS RECORD

A Weekly Newspaper Devoted to the Industrial, Financial, Railroad, Mining, Contracting, Engineering, Building, and General Business Interests of the South and Southwest

Vol. 70
No. 11

ESTABLISHED 1882

$4.00 Per Year
Single Copy 15 Cents

Many of the foremost experts of the United States have joined to make this issue,

The Chemical Potentialities of the South

one of the most notable publications ever sent forth by any American newspaper.

In more than sixty pages they tell such a story of the South and its resources, and its relation to the Nation's prosperity in peace and its safety in war, as was never before given to the country.

BALTIMORE, SEPTEMBER 14, 1916

Classified Index, Pages 188 to 193. Alphabetical Index, Page 194. Classified Opportunities, Pages 168 and 169.

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MANUFACTURERS RECORD

A WEEKLY SOUTHERN INDUSTRIAL, RAILROAD AND FINANCIAL NEWSPAPER

Trade-Name Registered in the U. S. Patent Office

Vol. LXX, No. 11. Weekly. | BALTIMORE, SEPTEMBER 14, 1916. | $4.00 A Year. Single Copies, 15 Cents

PUBLISHED EVERY THURSDAY BY THE
MANUFACTURERS RECORD PUBLISHING CO.

RICHARD H. EDMONDS, Pres. VICTOR H. POWER, Treas
FRANK GOULD, Vice-Pres. I. S. FIELD, Sec'y.

RICHARD H. EDMONDS, Editor and General Manager

BRANCH OFFICES:
NEW YORK, 52 Broadway CHICAGO, 1409 Fisher Bldg.
BOSTON, 733 Old South Bldg. ST. LOUIS, 608 Century Building

Subscription $4 a year (payable in advance) to United States, Mexico, Cuba, Porto Rico, Hawaii and the Philippines. To Foreign Countries (including Canada) in the Postal Union, $6.50 a year.

[Entered at the Baltimore Postoffice as second-class matter.]

In order to avoid delays, all correspondence pertaining to news or advertising matters should be addressed directly to the Manufacturers Record, Baltimore, Md., and not to individual editors, officers, employes or any branch office.

THIS ISSUE.

This issue is mainly devoted to special articles on the chemical potentialities of the South. All regular matter has necessarily been condensed into a few pages, which will be found beginning with page 141.

WELCOME TO CHEMICAL EXPOSITION BOOTH OF MANUFACTURERS RECORD.

A CORDIAL invitation is extended to the members of the various chemical and technical societies, as well as to all others attending the National Exposition of Chemical Industries at the Grand Central Palace in New York, the week of September 25-30, to visit the booth of the Manufacturers Record, on the second floor of the Exhibit Hall.

Especially do we invite the chemists, chemical engineers, business men, public utility officials and others from the South or identified with Southern properties to make our booth their headquarters and join with us in showing visitors that the South, with its vast stores of diversified minerals, water powers, railroad facilities and other advantages, offers unequaled opportunities for chemical development.

We shall have on file information relating to some of the raw materials and resources of the South available for chemical, mineral and allied industries. This data is for your benefit and will be freely placed at your disposal.

If you are seeking any facts about the sixteen Southern and Southwestern States, we will gladly furnish them or place you in touch with those who can.

The Meaning of This Special Issue: The Chemical Potentialities of the South.

ON August 1 the MANUFACTURERS RECORD decided to undertake this special issue and to designate it as "The Chemical Potentialities of the South."

We knew that the time was limited and that many of the men upon whom we desired to call for special articles were away on their summer vacations. But a list was prepared of those from whom we especially desired to have articles on various phases of chemical and industrial opportunities in the South. To some of these men letters were written explaining the matter; to others telegrams were sent, giving some brief details and asking for their co-operation through special contributions. Some of the men of whom these requests were made were so crowded that it was impossible for them to comply; but, with remarkable unanimity, we were able to secure a promise from nearly all of those who were asked to write special articles. The readiness of the great leaders to co-operate in this way was strikingly illustrated in three cases, which typify many.

To Dr. Arthur D. Little of Boston a telegram, explaining the matter, was sent to a summer resort in Maine, where he was known to be stopping, and this was followed by a letter giving full details. To the telegram Dr. Little replied that he was away on his summer vacation, and that he so sorely needed rest that he could not undertake to write an article for this issue, because it would require his return to Boston in order to secure the necessary data at his office. But when the letter reached him, explaining the matter and its importance, he wired that he would accept the invitation, and he promptly left one of Maine's most popular resorts and went to Boston to prepare his illuminating contribution to this issue.

Dr. Ira Remsen, the great chemist of Johns Hopkins, who has taught so many of the great chemists of the country, was on an island off the coast of Maine. Recognizing the far-reaching importance of this undertaking, he wired, immediately upon receipt of our request, that he would comply. Then, without a stenographer available, without any reference books or data at hand, he penned twenty-seven pages of manuscript, and when proof reached him he walked three miles to get it into the postoffice in time.

Dr. Charles H. Herty, president of the American Chemical Society, stopped for a few moments in Baltimore on his way back from Washington to a summer camp in Maine. He, too, was seeking a much-needed rest, and at the same time was so pressed with the preparation of many important technical papers and with the fight before Congress in behalf of a tariff on dyestuffs that he had established himself in a tent far away from his summer camp and with instructions that he should not be interrupted. When the first request for a special article was made, he threw up his hands and insisted that compliance was impossible. In a few moments he, too, had yielded and hurried back to Maine to add this contribution to the other pressing work that he was doing.

From Dr. Phillips, in far-away Colorado; DeKalb, in Arizona; Dr. Day, then in Wyoming, all of whom had to be reached by wire, came equally as prompt responses.

It is an interesting fact that without a single exception every man who promised an article fulfilled his promise, and every man but one had his manuscript in this office within the time limit set, and that one had a valid excuse. This, in itself, is an amazing illustration of the value of scientific training and the thoroughness with which such men keep their engagements. In this very fact these distinguished writers, who took time for special work when already overcrowded or while seeking much-needed rest, and fulfilled their engagements so that only one fell short of the day named—and his excuse was a good one—have given an illustration of why they have become great leaders in science and in industry. We venture to say that none of these are eight-hour-day men, that none of them ever timed his work by the hands of the clock, and that none of them ever had to utter a word about lack of opportunity in this country.

These men were not born to wealth, no silver spoons were ever found in their mouths, no fortuitous circumstances brought honor and position to them. They achieved because they concentrated their whole brain and body power upon study and investigation and work. They succeeded because they deserved success. They should be an inspiration to all young men who are willing to follow the path they have traveled and where they have blazed the trail.

They have rendered the nation a splendid service in their contributions in this issue by showing how the nation's progress in peace and safety in war can be made sure through the utilization of the natural resources for chemistry and general industrial activities in the South.

"THE COWARDLY SURRENDER BILL."

THE criticisms by the MANUFACTURERS RECORD of Congress and the President for passing what a Baltimore banking house aptly calls "the cowardly surrender bill" have called forth many letters of enthusiastic commendation, especially from the South. Limited space makes it impossible to use them this week, but next week we shall return to this momentous legislation, which is fraught with infinite danger to our country.

In the face of this situation he who fails to study and give voice to his views on this matter is recreant to his responsibility to democracy, to civilization and to the nation.

American Leaders in Science and Industry Discuss the South.

MOST IMPORTANT SYMPOSIUM EVER PRINTED, DEALING WITH THE RESOURCES AND POTENTIALITIES OF THE SOUTHERN STATES AND THE RELATION OF THIS SECTION TO THE NATION IN TIME OF PEACE AND WAR.

MANY of the foremost scientists of the United States in this special issue, entitled "The Chemical Potentialities of the South," discuss, from many angles, the material resources of this section and how they can be made to add to the nation's wealth in peace and to give security to the nation in time of war.

We do not believe that any other publication in this country ever carried, in any one issue, such a remarkable list of remarkable articles by so many of the foremost leaders in chemistry and industry in the United States.

This symposium shapes itself into a composite story of absorbing interest. It will necessarily broaden the thought of the whole country as to the South. It will awaken everywhere a realization of the fact that the South is indeed the nation's greatest undeveloped asset, and that the utilization of the South's resources to the largest extent possible is absolutely essential to the rounding out of national prosperity and to the safeguarding of the nation's life in war.

The list of the writers and the titles of the articles for this issue include the following:

The MANUFACTURERS RECORD is sending a copy of this issue to every American member of the American Chemical Society, of the American Iron and Steel Institute, of the American Electro-Chemical Society, and to some thousands of other leading business men—manufacturers and bankers—throughout the country, in addition to its regular circulation. The issue will have a distribution of over 27,000 copies.

This, we believe, will be the largest and most desirable circulation ever given to any publication in this country in the interest of the development of any section of the country. It will be worthy of the writers and of their splendid contributions.

My Country, 'Tis of Thee: The South's Relation to the Nation in Peace and in War.

TO a very large extent, as seen now in the light of European conditions, the development of our country has been of a haphazard character. We have been doing pioneer work in utilizing the resources nearest to hand and most easily developed, without giving any thought to a broad co-ordination of railroads, of iron and steel and chemical industries, and of highways, taking no account of war possibilities nor considering the interdependence of all agricultural and industrial activities.

We have viewed these things only from the standpoint of the pioneer who enters upon the settlement of a new country, having in mind merely immediate necessities without far-reaching consideration of what the future may bring forth. The pioneer's method is the natural one; indeed, the only feasible one, considering his facilities and his needs; but the pioneer advances his work to a higher order as rapidly as his environment and his mental attainments make possible. As a nation we are passing out of the pioneer stage.

As we study this situation we realize that all that we have achieved is merely the clearing of the land, the pulling up of the stumps, the grubbing of the ground and the digging of the foundation for building our business structure.

Is it not true in our industrial activities that until now we have been merely day laborers and apprentices and mechanics, utilizing the things immediately at hand for our daily work.

Having passed through the stage of the apprentice and the mechanic, we are ready to take charge of the shop and begin to do business. We are now at a point where we can, as a nation, intelligently study our tools and see wherein the shop is deficient and wherein it is well equipped. We are beginning to know more about our raw materials and how to handle them to meet the world's competition.

Henceforth we must consider the United States as a great workshop—indeed, the workshop of the world—and it becomes necessary for us to study its size and its tools and its power equipment—its power being its people and its resources its tools—and to know what it has already accomplished in comparison with what it must do in the future.

In round figures, the United States has about 3,000,000 square miles, or 6 per cent. of the total of 50,000,000 square miles of the world's land area.

We have about 6 or 7 per cent. of the world's population.

With a land area of 6 per cent. and a population of about 6 or 7 per cent. of the world's, we have accumulated $200,000,000,000 of wealth, or more than 25 per cent. of the world's accumulated wealth.

We have 257,000 miles of railroad, or over 37 per cent. of the total railroad mileage of the world.

We are producing about 40,000,000 tons of pig-iron, or more than one-half of the world's output.

We are mining over 500,000,000 tons of coal, or nearly one-half of the world's production.

We produced last year 281,000,000 barrels of petroleum out of a total for the world of 426,892,000 barrels, or over 53 per cent. of the world's output.

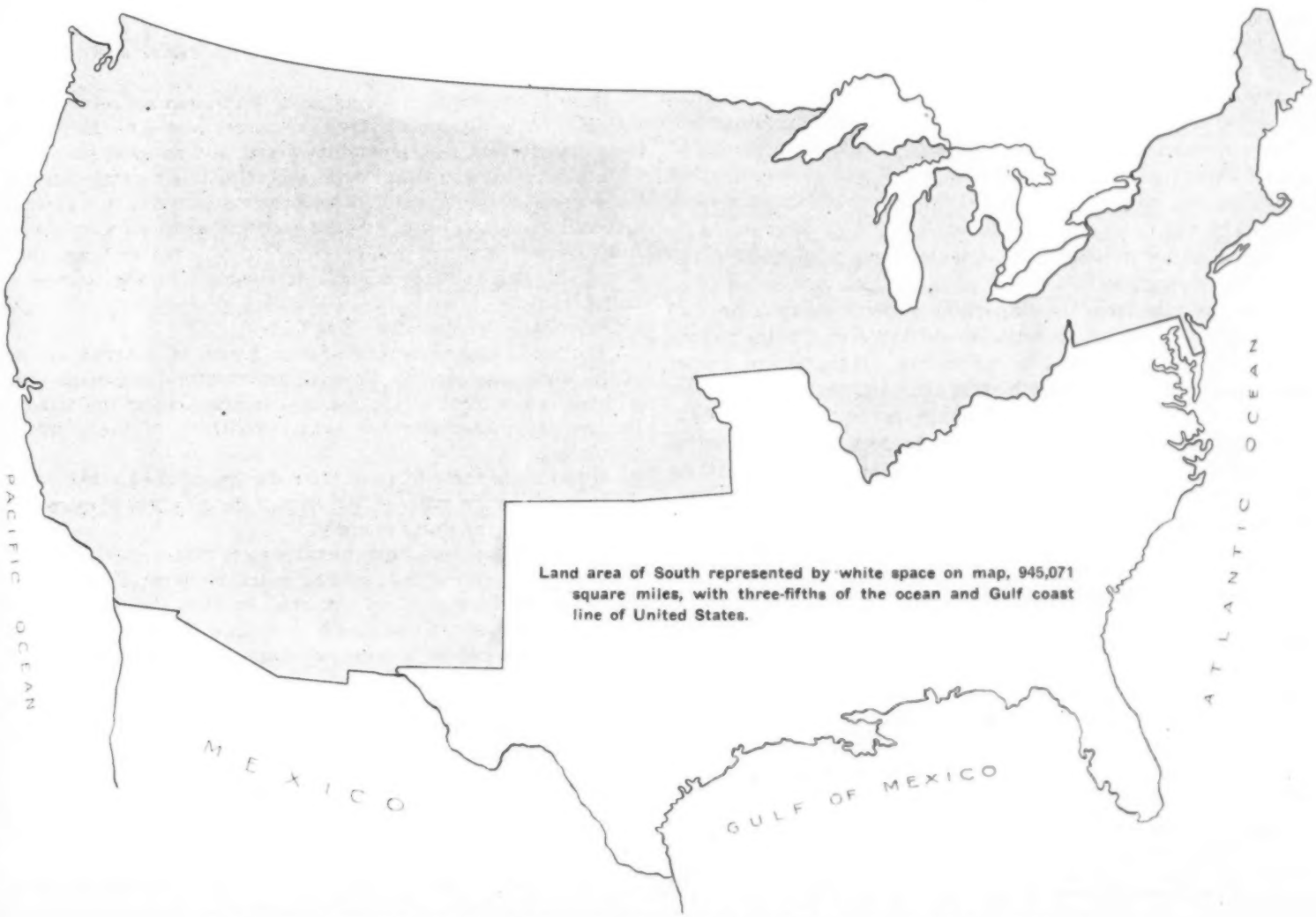
We are growing more than 60 per cent. of the world's cotton.

We are annually growing between 5,000,000,000 and 6,000,000,000 bushels of grain.

The value of our manufactured output was over $24,000,000,000 in 1914, and is now running at the rate of probably over $28,000,000,000 for 1916.

Our agricultural products are now over $10,000,000,000 a year.

In manufactures, as in agriculture, we have merely been



Outline map of the United States, showing geographical relation of South to the rest of the country.

pioneering, whereas, henceforth, we shall be doing the advanced work that follows the chemist and the expert, with their scientific research.

Our agricultural output of $10,000,000,000 a year, great as it is, can be almost doubled without much increase in acreage when we come to the full utilization of the work of chemistry and the highest science in fertilization and in agricultural methods. In this way soil fertility can be greatly increased, our average yield in grain and cotton and other things materially advanced, and in many cases doubled. In this field of activity the work of the scientist becomes as essential as in the upbuilding of manufactures and in the creation of industries in which chemistry is supreme.

The achievements which have been made in agriculture, in manufactures and in wealth accumulation were possible because we have a country of almost illimitable natural advantages. We could hardly have prevented this amazing development even if we had sought to do so. Our natural resources and climatic advantages have forced this growth and our marvelous wealth and have given us our economic strength.

While Europe is spending its billions and billions in destruction, we are accumulating billions and billions out of construction activities.

We are piling up wealth which makes us the envied of all the world. If there ever was, on the face of the earth, any country whose wealth and helplessness invited attack from the envy, the cupidity or the hatred of other nations, this is the land. Never was there a situation in the world's history like it, and he who shuts his eyes to this danger is like the ostrich which buries his head in the sand and thinks no evil can happen to him because he cannot see his enemy.

This war has demonstrated, as nothing else in human history has done, that civilization has not reached the point where all men and all nations are controlled by the spirit of Christianity.

It becomes necessary for us, therefore, as we study the limitless wealth with which nature has endowed us, to recognize that our very riches are our danger, and henceforth, laying aside all sectional questions, seeking only the good of the whole country, and recognizing that there is no North, no South, no East, no West, but one common, united land, study our industrial and agricultural, commercial and railroad interests from the viewpoint of co-ordinating national development, and in this co-ordination safeguard the nation's life should we ever, unfortunately, be engaged in war.

No American in whose breast there burns a spark of patriotism has a right, at this late day, to consider any economic or political question from the standpoint of sectionalism. He who would thus deal with any question would be recreant to his responsibilities to the nation and to civilization. It matters not what may have been his sectional bias in the past, the time has now come for the welding of the nation into one homogeneous whole. It might almost be said that the man who does not recognize this situation, and who thinks only of his own State or his own section and the relation which any material development has upon that, rather than upon the nation as a whole, is, in reality, not a patriot, for he is failing at a vital point in national character. It matters not whether this man be of the South and seek Southern development from a purely sectional viewpoint, or whether he be of the North or the West and seek the development of his section against some other, on sectional lines, he is in either case false to his country's welfare. The MANUFACTURERS RECORD would not if it could pull down a single industry North or West to transfer it to the South. There is room enough for all, but we would stress the supreme importance of building new industries in the South on the broad ground that "the development of the South means the enrichment of the nation."

The time has come—and the European war has intensified the truth of this as nothing else could have done—when North and South and East and West, in one glad refrain, should sing, "My Country, 'Tis of Thee." It is not, "My Section," nor "My State," but "My Country."

THE RELATION OF THE SOUTH TO THE NATION'S PROGRESS.

It is in this light and from this viewpoint that the MANUFACTURERS RECORD, through this issue, is advocating, as it has done for the last third of a century, the upbuilding of the South. As it was impossible, from Lincoln's viewpoint, for a nation to be part slave and part free, so it is impossible for a nation, without endangering its future, to be developed in spots, with all great industries concentrated in limited areas, while other sections are without industrial activities on a broad scale. Pre-eminently is this true as to the question of National Preparedness for peace or for war.

If we look for a moment at the accompanying map, showing the South in relation to the United States, we shall be impressed with the truly remarkable strategic importance of this section to the nation.

The South, with nearly one-third of the nation's land area, has about three-fifths of the nation's coast line.

This coast line, on the Atlantic and the Gulf of Mexico, in its wide sweep encircles in part the very heart of the country.

This area, which stretches from Maryland to Texas and from Missouri, bordering on Iowa, to the long arm which Florida thrusts out into the warm waters of the Gulf Stream, is vital to the nation's existence. Here is a region which no American can overlook. Some, perchance, may have thought of the South as a small and distant section of our country, but this map impresses, as nothing else could do, the magnitude of the South in relation to the nation and the geographical location of the South as it bears on world commerce and on the life of the nation in time of war.

The South's area of 945,000 square miles, out of 2,974,000 square miles as the land area of the country, is probably richer in natural resources than any other equal area in the world. This is the testimony of many recognized authorities of other sections. In this issue many of the most noted experts in America, without bias or prejudice in favor of the South, tell of its amazing material advantages. This is the mighty, undeveloped asset of the country. Its development would mean the rounding out of national life and the creation of wealth in which the whole country would share, for it is not possible to utilize the South's resources without benefiting every section from the Atlantic to the Pacific and from the Gulf to the border of Canada.

Here is practically a virgin field, with amazing resources as yet only partly developed. These resources belong to the nation; their development means national wealth and national safety.

The broadest and safest development of this country can only be secured by the broadest development of the nation's greatest material asset, the South. So long as this section does not keep full step with the material development of other sections, there cannot be well-rounded national development or the fullness of national life.

In brief, let us consider a few facts.

The South, the most Anglo-Saxon region of America—if not of the world, considering the small intermixture of foreign blood with the white blood of the South—comprises about one-third of the country's area and has nearly one-third of the country's population.

It has about three-fifths of the coast line of the United States.

It produces the entire cotton crop of the country, or more than 60 per cent. of the world's supply.

It is already growing considerably more than one-fourth of the nation's grain crop and is making much more rapid progress in grain production than other sections. In 1915 the total value of the farm products of the South, including livestock, was about $3,600,000,000 out of a total of about $10,000,000,000 for the United States.

The total value of its farm crops (not including livestock) in 1915 was $2,600,000,000, compared with $4,180,000,000 for the rest of the country, and this year's proportion, by reason of better prices for cotton, will probably be even larger.

The South has about one-half of the standing timber of the United States and is producing over 56 per cent. of the lumber cut of the country.

The grain crops of the South in 1915 aggregated nearly 1,600,000,000 bushels out of a total for the country of 5,685,000,000 bushels.

The South produces three-fourths of the sulphur of the world and absolutely dominates the world's sulphur trade.

It has about three-fourths of the coking coal supply of the country.

It has 88,000 square miles of coal land, or double the entire coal area of Europe and nearly five times the coal area of all of Europe excluding Russia. It also has enormous areas of lignite.

It is the center of oil and gas activity, and produced last year 150,751,000 barrels, or nearly 54 per cent. of the oil of the entire country and over 35 per cent. of the world's output of oil.

It has over 5,000,000 undeveloped water-power, and which can be greatly increased by the scientific development of storage reservoirs.

And yet, with all of these and many other natural advantages, greater, we believe, than those given to any other equal area on earth, it has not had the wonderful development of business and the marvelous accumulation of wealth seen in other sections, though its progress, as shown elsewhere, has indeed been great.

The South's resources should be utilized not only for the benefit of the investors, but for the betterment of the nation. Its intimate relation, from the viewpoint of its coast line and its natural resources, to the welfare of the nation, affording a foundation for the creation of wealth for the whole country, should make the National Government, the financiers, the chemists and the iron and steel men of the country recognize the supreme importance, from every point of view, of the fullest development of the South.

TWO ANGLES FROM WHICH TO STUDY THE SOUTH.

There are two angles from which to view the South. One is the smallness of its present industrial development and wealth as compared with other sections. When viewed from that angle only we cannot boast of what has been accomplished, for then we have to contrast the capital invested in manufacturing in 1914 in six of the leading States of the central South, most richly endowed with mineral wealth, with the single State of Massachusetts, and we have the following:

TOTAL CAPITAL INVESTED IN MANUFACTURING IN 1914.

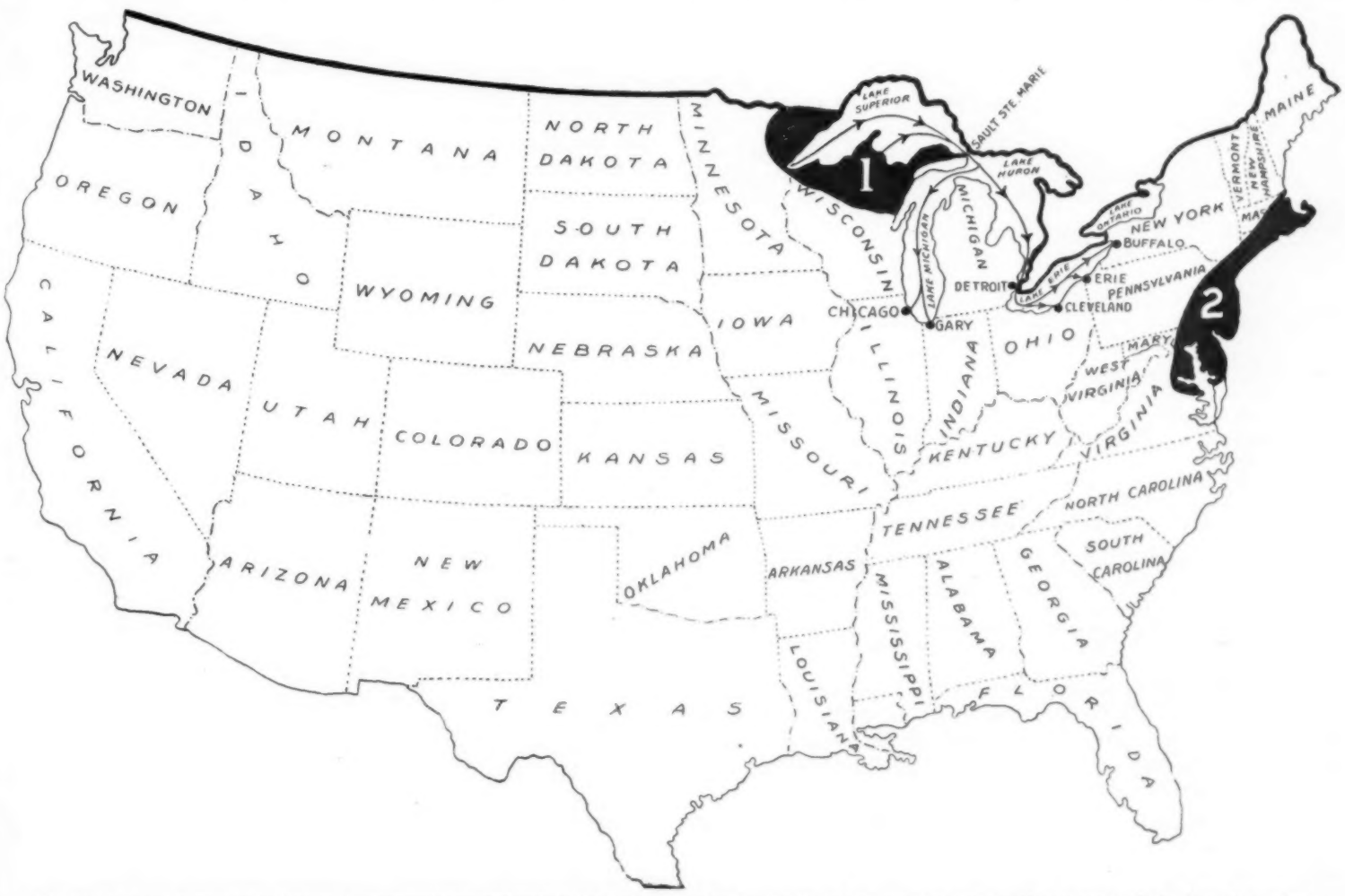
Virginia	$261,501,000
North Carolina	253,842,000
South Carolina	203,211,000
Georgia	258,849,000
Alabama	213,062,000
Tennessee	211,423,000
Total	$1,401,888,000
Massachusetts	$1,548,961,000

These figures show that the one State of Massachusetts, having only 8000 square miles of area and practically without any natural advantages in the way of raw materials, in 1914, had $146,000,000 more capital invested in manufacturing within the limits of the State than the six Southern States named, whose resources baffle description, had invested in industrial activities.

The entire capital invested in manufacturing in the sixteen Southern States, which include Missouri and Oklahoma and the District of Columbia, was $3,487,000,000. These figures loom large until we stop to remember that Pennsylvania has invested in manufacturing, or had in 1914, the year for which all of these figures are given, a total capital of $3,149,000,000, while Illinois had $1,943,000,000 and Ohio had $1,677,000,000.

By contrasting these figures the South's industrial development seems very small. The true way, however, of looking at this situation is to give free rein to the imagination and forecast, based on natural advantages, the amazing advance that the South is destined to make as year by year these resources become better known and their development is more vigorously pushed, and as its growth gathers the momentum of capital to match the industrial capital of the New England States as well as of the central West.

Viewing the South from the other angle, the situation appears altogether different. When we compare the population of the United States in 1880 with that of the South at the present time,



The black space indicated by Figure 1 represents approximately the Lake Superior ore fields, which produce nearly 90 per cent. of the iron ore output of the United States., and that represented by Figure 2 indicates the limited area in which nearly all of war munitions, of guns, large and small, explosives, etc., are produced. The danger of the whole situation is apparent.

and some of the striking phases of industrial development in the South with the United States in 1880, we gain a better idea of what the South has really achieved in rebuilding its fortunes since the complete wreck and ruin of the Civil War. It is not out of place to remind readers of the MANUFACTURERS RECORD that for four years the South, with all of its ports blockaded, with its western border cut off from communication by a land blockade as close as that of the water blockade by the Union Navy, starting without a Government, without an army or a navy, without munition plants, for four years maintained the unequal struggle against overwhelming odds until at the close of the war there was absolutely nothing left but a thin gray shell which then completely collapsed.

The South had exhausted itself in the struggle. It had used up its livestock to feed its soldiers. It had paid its bills in promises which had nothing on earth but faith to back them, and at the close of the struggle its exhausted armies of exhausted men had to go back to exhausted farms. Without implements or capital, with its labor system completely disorganized and its former slaves, for ten years, masters in the legislative halls of many of its States, it had to meet conditions which few people in the history of the world ever had to face.

In addition to the loss of some hundreds of thousands of its foremost men on the battlefield and through disease due to war and to the complete sweeping away of all wealth and the destruction of homes and cities, the South for years had to face a steady drain of emigration due to the lack of employment such as no other country in modern times has ever had to meet. Between 1865 and 1900 about 3,500,000 Southern whites went entirely beyond the borders of the Confederacy and helped to create the prosperity of other regions, while about 1,500,000 went out into Texas and other parts of the Southwest. This made a drain on the central South from Virginia to Mississippi of about 5,000,000 whites, sapping the vitality of this section and throwing on those who remained the burden of the re-establishment of law and order, the saving of the South to Anglo-Saxon civilization, the development of business and education, and the maintenance of all that makes for human advancement.

It is in the light of such a situation as this that the South's progress should be studied, for in no other way is it possible to fully measure what has and what has not been done. When studied from this angle we can see that the South of today, judged by what it has already achieved, has a wonderful future before it. A few figures, which could be indefinitely extended, contrasting the United States of 1880 and the South of 1915, bring out the progress of the South most strikingly:

	United States in 1880.	The South in 1915.
Population	50,396,000	35,235,000
Land area, square miles	2,974,159	945,088
Capital in manufactures	$2,790,273,000	$3,487,000,000
Active spindles in cotton mills	10,653,000	*13,300,000
Active looms in cotton mills	226,000	270,000
Pounds of lint cotton used	750,344,000	1,919,811,000
Coke made, tons	3,338,000	6,300,000
Lumber cut, feet	18,125,432,000	20,865,000,000
Value of agricultural products	†$2,212,541,000	†$2,600,000,000
Coal mined, tons	71,482,000	142,887,000
Petroleum produced, barrels	26,286,000	150,751,000
Phosphate mined, tons	211,000	‡3,111,000
Portland cement, barrels	42,000	15,431,000

*To which might be added about 500,000 spindles now being installed or contracted for to go into new mills.
†Does not include value of livestock products.
‡1913 output used because of normal conditions before the European war.

Thus while the South has 15,000,000 less population than the United States had in 1880, its agricultural and industrial interests as measured by capital invested in the latter and the value of the output of the former far exceeds all that the 50,000,000 people of 1880 were doing in agriculture and manufactures.

The consumption of cotton in Southern mills is about two and one-half times as much as the consumption of cotton in all United States mills in 1880.

The capital invested in manufactures in the South now exceeds by $697,000,000 the total capital invested in manufacturing in the entire country in 1880.

The output of coke in the South is nearly twice as great as the output of coke in the United States in 1880.

The production of coal is almost exactly twice as great in the South at present as was the production of coal in the United States in 1880.

This section is now producing nearly six times as much petroleum as the United States itself produced, and in the output of phosphate and sulphur and Portland cement the change is so great that percentages fail in telling the story, for to a large extent the phosphate, the sulphur and the cement industries are creations since 1880.

If the South, hampered by all of the adverse conditions under which it labored for many years after the war, retarded in its development by the concentration of all the power of the financiers of the East upon the development of the East and the West, to the exclusion of the South—a condition which existed for so many years and which, to some extent, still exists—has been able to fight its way upward until in the industries mentioned and in many other lines of activity it is so far ahead of what the entire country had achieved up to 1880, who shall set the measure of its future growth, now that the world's interest is being centered upon this section, and now that the foremost chemists and metallurgists of this and other lands are realizing that it has advantages not vouchsafed to any other equal area on earth?

The experts who through this issue are helping to make known the potentialities of the South are rendering a great service to the nation. They are giving the weight of their authority to a combined statement of the resources of this section, and in doing this are helping to lay the foundation for the broadening of the life of the South, and that means the broadening of the life of the nation. On behalf of the South the Manufacturers Record would express its appreciation of the quickness and the interest with which they responded to its call for their views upon this section and its chemical and industrial resources.

In the matter of national preparedness, a subject which must command the attention of all thoughtful men, it is easily seen that the only possible insurance policy that can be issued to guarantee the safety of this country in time of war is in the hands of the South. It can offer to the nation a policy based on resources which, if utilized by the business men of the nation through the development of this region, will safeguard it in time of war and vastly enrich it in time of peace.

THE DANGER TO THE COUNTRY SO LONG AS EXISTING CONDITIONS IN IRON AND STEEL AND MUNITION CONTINUE UNCHANGED.

Map No. 2 is intended to show by the black spots approximately the relation to the rest of the country of the Lake Superior iron-ore district and of the small territory on the Atlantic coast where nearly all of our war munitions are produced.

The limited area of these two spots, marked by figures 1 and 2, are in striking contrast with the area of the whole country. The danger of depending upon an ore supply contiguous to another country and of a munition supply in a limited area along the Atlantic coast, and subject to capture, cannot be better indicated than by this map.

Figure No. 1 in this map represents the Lake Superior iron-ore district, which last year produced 46,944,254 tons of ore out of a total of 55,526,490 tons for the United States, or 84.5 per cent. This year the Lake Superior district will produce probably between 55,000,000 and 60,000,000 tons, which will be a larger percentage of the total than the figures of last year.

The arrows indicate the water routes of this ore through the Sault Ste. Marie or Soo canals on the American and Canadian sides. The ore passes through these canals and down the lakes to Chicago, Gary, Detroit and other ports. From some of these Lake points the larger proportion of it is shipped by rail to Pittsburgh and other Pennsylvania furnaces.

As the average metallic contents of the Lake Superior ores are somewhat higher than the average of other sections, that district furnished the raw material for about 90 per cent. of the pig-iron output of the United States. When to this we add the foreign ore

imported, we have two sources of supply, from which nearly 95 per cent. of the steel production of the country is produced.

If this small ore district contiguous to Canada were captured by an enemy, about 90 per cent. of our iron and steel output would almost instantaneously cease, as stock sufficient for a few months only is carried, and the output of the mines and the capacity of transportation on the Lakes is taxed to the very utmost to take care of the daily needs of the furnaces. Or if the Soo Canal were blocked by dynamite or by capture, this ore supply would be instantaneously cut off. Thus, by the capture of the Lake Superior district, or by the blocking of the canals, 90 per cent. of our iron and steel output would be shut off, making it impossible for us to continue defense against an enemy who had captured that district or closed the canal, because it would then be too late to open up new mines and build new plants.

The capture of that district would compel us to accept any terms our conqueror dictated.

Is it wise to take so great a risk?

Figure 2 indicates the limited area along the Atlantic coast, stretching from Massachusetts to Virginia, in which is concentrated practically all of the munition-making industry of the country. Here are most of our powder mills, our gun shops, our shell-producing plants and our rifle-making industries. In this little stretch of territory along the border of the Atlantic coast from Massachusetts to Virginia are concentrated practically all of the munition-making industries which would be our only source of supply in time of war. The stretch of country from this little black section to the Pacific coast and to the Mexican line is almost bare of munition-making industries. Our country, with its more than 100,000,000 people, with its resources in iron and coal and other minerals, is dependent upon one little area on the Canadian border as the basis for 90 per cent. of its steel and upon another little spot along the Atlantic coast for practically all of its war munitions. That the Lake Superior ore district could be captured and that the Soo Canals could be blocked are known to every intelligent man who has considered the matter.

The capture of the Atlantic coast munition section by an invading enemy—and every army and naval officer will say that under present conditions and for some years to come such a capture would be entirely feasible—would completely shut off our supply of guns and ammunition and make practically impossible for years to come any successful defense.

Is it wise for the nation to live in such a fool's paradise of imaginary safety?

The production of iron ore in the United States for the years 1910, 1914 and 1915 was as follows:

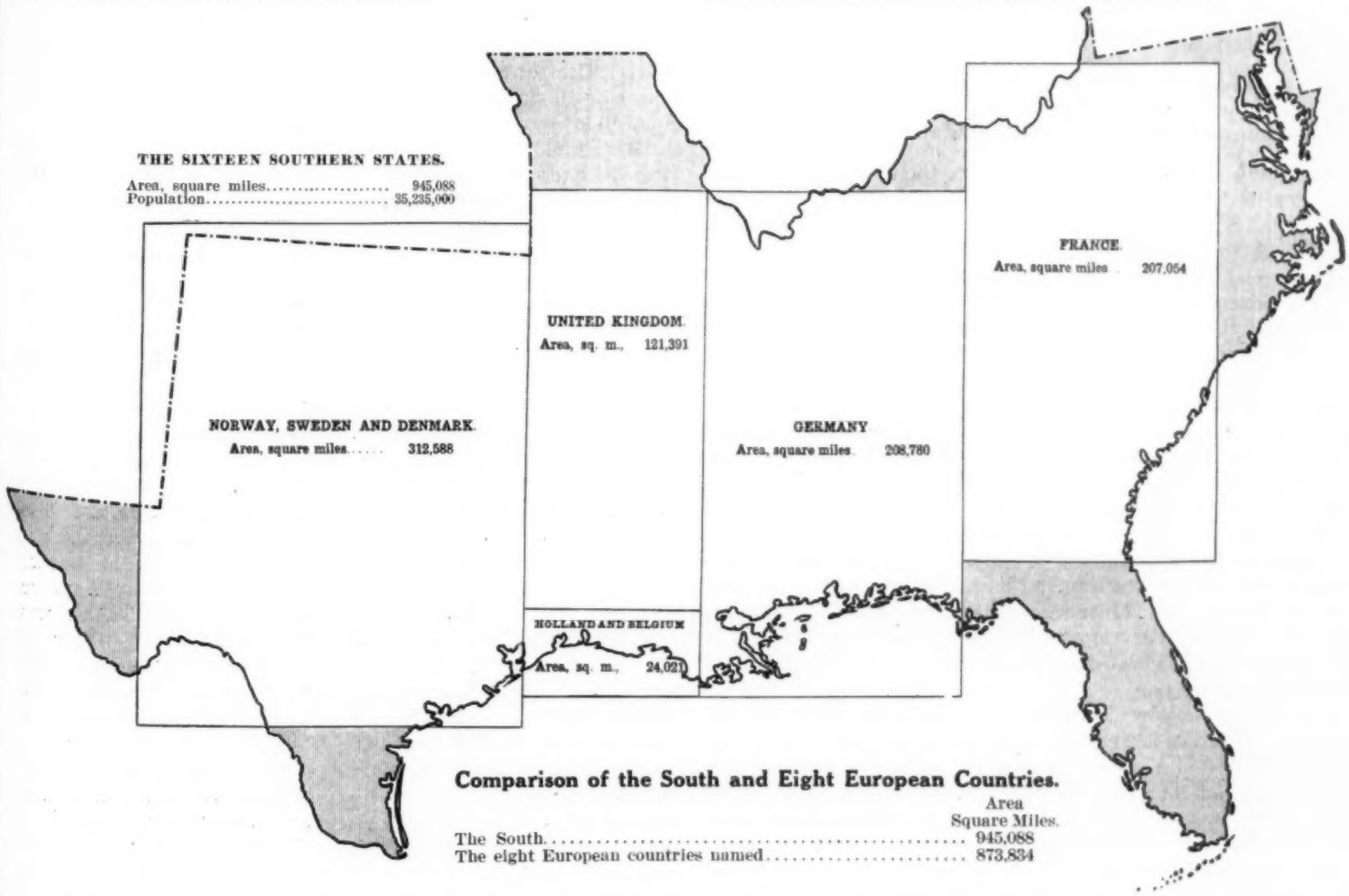
States.	1910. Tons.	1914. Tons.	1915. Tons.
Minnesota	31,966,769	21,946,901	33,464,660
Michigan	13,303,906	10,796,200	12,514,516
Alabama	4,801,275	4,838,959	5,309,354
Wisconsin	1,149,551	886,512	1,095,388
New York	1,287,209	785,377	998,845
New Jersey	521,832	350,135	415,234
Pennsylvania	739,799	406,326	363,309
Virginia	903,377	378,530	348,042
Tennessee	732,247	330,214	284,185
Georgia	313,878	67,722	115,701
West Virginia, Kentucky, Maryland, North Carolina	143,687	91,966	71,953
Missouri	78,341	37,554	40,290
Ohio	22,320	5,138	3,455
Other States	1,050,715	518,237	501,558
Total	57,914,906	41,439,761	55,526,490

Of this the production in the Lake Superior district was:

States.	1910. Tons.	1914. Tons.	1915. Tons.
Minnesota	31,966,769	21,946,901	33,464,660
Michigan	13,303,906	10,796,200	12,514,516
Wisconsin	1,149,551	886,512	1,095,388
Total	46,420,226	33,629,613	47,074,564

The percentage of the total production for 1910 was 81.4 per cent.; for 1914, 81.1 per cent., and for 1915, 84.8 per cent.

While the iron-ore section of Wisconsin is included in this map, the figures given for that State show that the output there is small, Minnesota and Michigan being the chief producers.



This outline map is intended to show that the area of the United Kingdom, Germany, France, Norway, Sweden, Denmark, Holland and Belgium is considerably less than that of the South. The blocks representing different countries indicate their relative area and their aggregate area as compared with the South.

In natural resources the South is in many respects far ahead of the combined resources of these eight European countries.

Though Pennsylvania produces nearly one-half of the iron output of the United States, it mined last year only 363,000 tons of ore, the ore production of that State having steadily decreased for many years.

The supply of Lake and foreign ores could be instantaneously shut off in the event of war. Until this situation is changed by the larger utilization of the ores of the South and Southwest, through the active co-operation of the leading iron and steel men and financiers of the country, all talk of "National Preparedness" is but a visionary dream that cannot be realized. Indeed, all talk of "National Preparedness," so long as these conditions last, will tend to give our country a false sense of security and thus add to its dangers if we do not utilize the present situation to develop munition-making, armor-plate manufacture and iron and steel production far away from the seacoast and in regions not dependent in any way upon Lake Superior or foreign ores. Every failure to recognize this situation will directly and deliberately endanger the safety of the nation.

National safety, therefore, as well as the rounding out and the co-ordinating of the industrial interests of the country, absolutely demands the recognition of this situation and the development, far away from the coast and from dependence upon Lake ores, of the abundant resources available for iron and steel, munition-making and chemical industries in the South and Southwest.

At the present time the iron and steel and kindred interests of the East and West are crowded to the utmost limit of their capacity, a condition brought about largely by the enormous war orders.

It would be a narrow and sectional view to take if the leaders of the country should satisfy themselves to secure out of this business the largest present profit possible, without regard to the future welfare of the country. It would be a narrow and selfish point of view for them to feel that they could afford to continue to concentrate their efforts upon the largest production of iron and steel and chemicals and munitions of war in existing plants and in plants that are now being built in older sections and fail to take account of the dangers we now face.

The safety of the Nation in the future may some day depend upon the broad development at present of the chemical and metallurgical interests of the South and Southwest.

According to the reports of scientists, the total production of petroleum in the Oklahoma, Kansas and Gulf section of the South has amounted, since the beginning of petroleum production in these States, to 955,000,000 barrels.

These scientists, however, are willing to state that the possible future production in these States can be at least 3,982,000,000 barrels, and this, too, without counting discoveries in oil which may yet be made along the Gulf coast or in other portions of these States not yet known as oil fields.

Moreover, owing to chemical developments, it is estimated that in the future oil will give in final results 100 per cent. more efficiency than in the past. Therefore, instead of the Oklahoma-Kansas and Gulf coast sections having exhausted about 24 per cent. of their oil, they have in reality used only about 12 per cent., counting on efficiency rather than on quantity.

According to the testimony of experts, the South has at least 2,500,000,000 tons of iron ore, and it has twice as much coal area as all of Europe, with other materials which could be made the basis of an industrial development and a "preparedness" campaign great enough to safeguard the nation's life in time of war and to enrich it in time of peace.

The country is now dependent upon Lake Superior ores for about 90 per cent. of its iron and steel output and upon these same ores and the iron and steel from them for its armor plate, and for its warships and for the guns with which to equip them, while for explosives we are depending upon Chile, thousands of miles away, for the nitrates without which explosives cannot be made; though unnumbered millions of tons of nitrates can be extracted from the atmosphere and the South has the water power that could be made available for doing this. This now wasted water power, running its course idly to the sea, and this atmosphere—unutilized so far as nitrates are concerned—could be made the basis for producing all the nitrates that we might ever need in case of war, and, at the same time, furnish the basis for the fertilizers needed to restore our wasted soil and guarantee foodstuffs to the country.

At Muscle Shoals on the Tennessee River there is available power greater than that thus far developed at Niagara, or over 500,000 horse-power. The utilization of this, the greatest single power site in the South for the establishment of a nitrate plant commensurate with the needs and with the situation, would guarantee the nation in time of war an ample nitrate supply for its explosives and guarantee an increasing supply of fertilizers at a lessened cost to meet the demands for foodstuffs, which treads hard upon the heels of supply. With a development such as this, that region could be a radiating point from which would go out influences of mighty moment for advancing agriculture and for lessening the cost of food production, while safeguarding the nation's life for foodstuff in peace and for foodstuffs and explosives in war.

It is difficult to exaggerate this Southern situation. That the MANUFACTURERS RECORD is not over-enthusiastic in its statements about the South may easily be seen by a study of the special articles in this issue. For instance, Dr. John C. Hebden, one of the leading scientists of the country, who is proving his faith by his works, says of the section stretching from the Potomac to the Alabama that it "probably contains a greater variety of mineral wealth than any other section of the globe." Dr. Allerton S. Cushman, Director of the Institute of Industrial Research of Washington, refers to "the almost limitless possibilities which lie ahead" of the South. Dr. Arthur C. Little, of Boston, former President of the American Chemical Society, writes: "The world has yet to learn that no region on earth can compare with the Southern States as a locus for chemical industry," and he also adds, "All the basic raw materials for a highly diversified chemical industry, conducted on a scale of magnitude which could supply the world, are available in super-abundance in the South." Dr. H. D. Ruhm, a widely known scientist, refers to the South as the "storehouse" of the nation because of its great riches of minerals awaiting capital and chemical skill. E. C. Eckel, Economic Geologist and Engineer, credits the South with 500,000,000,000 tons of serviceable coal and 2,500,000,000 tons of available iron ore.

Dr. W. R. Whitney, of the Research Laboratory of the General Electric Company, says the South has 5,000,000 undeveloped water power or 10 times the amount developed at Niagara and nearly equal to all that has been developed in the country.

Mr. Frank S. Washburn, one of the foremost authorities of the United States, says: "Nature has showered possibilities upon the Southern States beyond every other section of the United States," and, referring to the possibilities of utilizing the water-powers of the South for the production of nitrates and the manufacture of fertilizers, adds: "We see in the South, therefore, a most fortuitous combination of natural advantages, making for the production and utilization of a cheaply manufactured and cheaply distributed fertilizer. Nowhere else in the United States do these conditions exist."

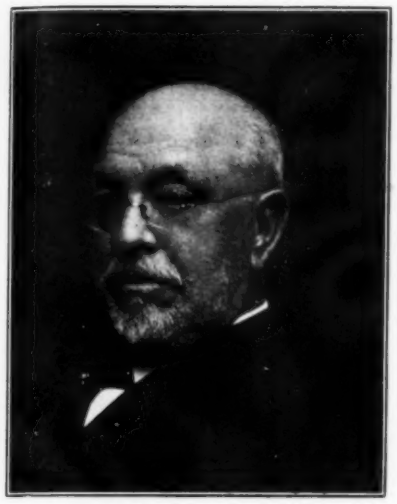
We cannot too strongly urge upon our readers the importance of a thorough study of every one of these special articles. The man who knows the facts presented in them will have a liberal education about the South and its relation to the country. He will know this section as he has never known it before, for there is probably no one man even among these great scientists who knows all of the facts about the South which can be learned through a study of this symposium. We venture to say that even such men as Dr. Remsen and Dr. Herty and Dr. Little and others will, in a study of this issue, learn many facts with which they are not now acquainted. If that be true of them, how much more true is it of the general business men, merchants, manufacturers, bankers and others, who have never had such an opportunity of thoroughly studying the South.

We have not sought in this issue to cover every detail of chemical potentialities; we have not sought to attract attention by any unusual cover design, or other features often used to make such special issues command attention. On the other hand, we have sought to make this issue as plain and simple and solid as the character of the men who are contributors to it, and the character of the articles which they have written. We send it forth to the world as a special contribution toward making known the resources of the South and how the development of these resources will enrich the nation in peace and save it from destruction in war.

Chemical Science and Chemical Industry.

By IRA REMSEN, Ph.D., LL.D., Johns Hopkins University.

CHEMISTRY is the science which deals with the composition of things and with the changes in composition which these things undergo. When a chemist is given a substance he asks, first, What does it consist of? second, How can it be decomposed? and, third, How can it be made? To be sure, a great many other questions arise in the course of his efforts to answer these three. A good illustration is afforded by that important substance, water, which plays such a controlling part in the world. Until the latter part of the eighteenth century water was regarded as an element, that is to say, as a substance which cannot be decomposed into simpler things. This idea came down from the earliest times and was part of one of the oldest chemical theories, according to which all things in the universe consist of the four elements—earth, air, fire and water. Towards the end of the eighteenth century Priestley and Cavendish in England, Scheele in Sweden and Lavoisier in France, while engaged in the study of gases, showed that water consists of two gaseous substances—hydrogen and oxygen; that it is formed when hydrogen burns in the air, that the air consists of oxygen and nitrogen, and that burning or combustion consist in the union of the burning substance with oxygen. These discoveries furnish the basis of scientific chemistry. They were great discoveries. They were fundamental. All chemical investigation in the century following and down to the present time has felt the effect of these discoveries and in a large sense has been the result of them.



IRA REMSEN, Ph.D., LL.D.

Who were these men? Priestley was a Unitarian clergyman who became interested in gases by seeing the bubbles formed on the surface of the fermenting liquid in a brewery near his house in Birmingham, England. He did more than anyone else has ever done in the way of showing how to work with gases, and he discovered a number of gases. His principal discovery is that of oxygen—probably, all things considered, the most important chemical discovery ever made. His theological views did not please his neighbors, and after his dwelling had been mobbed, and he had been subjected to a number of other incivilities, he emigrated to America and took up his residence at Northumberland, Pennsylvania, where he lived until his death.

Cavendish was said to be "the richest scientific man and the most scientific rich man of his time." His sole pleasure in life was scientific investigation. He was a recluse almost unknown to his cotemporaries. He worked alone and evidently without any thought of fame. Yet his name is immortal. His discoveries have exerted a lasting influence. Among them is one without which it seems doubtful whether the present disastrous war could continue. He showed that when electric sparks are passed through air the oxygen and nitrogen combine, and with water the product forms nitric acid. Now all explosives are made with the aid of nitric acid, so that it may be said that without nitric acid modern warfare would be impossible.

Scheele was a poor apothecary in Stockholm. He made a larger number discoveries than any other chemist. The two that stand out most prominently are oxygen and chlorine. His discovery of oxygen was made quite independently of Priestley's, and, curiously enough, in the same year, 1774. Chlorine is a disagreeable, yellowish-green gas that acts disastrously upon the throat and lungs, causing death in a short time. This is one of the gases used in the present war, the effects of which have so frequently been described in the accounts of the fighting on the western front. But chlorine is a substance of great practical value as a bleacher and disinfectant; as a solvent for gold in working up low-grade gold ores; and in the manufacture of chloroform, chloral and a large number of products useful in the dyestuff industry. Scheele remained poor until his later days, when he married a well-to-do widow.

Lavoisier was one of the most brilliant chemists—perhaps the most brilliant—the world has known. He did an immense amount of valuable work and is often called the founder of chemistry. A well-known French chemical writer has used these words: "Chemistry is a French science; it was founded by the immortal Lavoisier." Of course, this statement can be criticized, as it has been, severely, but it remains true in a large sense, and we need not quarrel with it. Lavoisier was undoubtedly the first one clearly to recognize the significance of the discovery of oxygen, and his work showed what rôle oxygen plays in combustion. Up to his time the prevailing theory in regard to combustion was what is known as the phlogiston theory, according to which combustion is due to the escape of an imaginary subtle substance called phlogiston. A substance that could burn was supposed to contain this subtle thing. One that could not burn was supposed not to contain it. That theory had a tremendous grip on the minds of chemists for about a hundred years, and even the wonderful work of Lavoisier, which is so convincing, did not cause the complete overthrow of this theory. Priestley and Scheele, for example, whose work furnished Lavoisier with the clue to his great conclusion, were not convinced and remained phlogisticians to the end of their days.

Lavoisier paid a large price for his brilliant career. He was beheaded in the French revolution.

I have called special attention to the work of these men and to the men themselves because they illustrate the highest type of work and of men that have brought about the advance of chemistry.

It would be interesting to take up briefly the work that followed and to characterize the important discoveries which form the groundwork of the present science; but that would mean writing a concise history of chemistry. That, of course, is out of the question under the present circumstances. I shall, however, refer to a few of the most conspicuous and important of the great discoveries that have led to the development of the science, for it is well for all who are interested in chemistry and its applications to bear in mind the record of the past. This record teaches a lesson of great importance to the present.

The atomic theory has contributed greatly to the advance of chemistry. It has controlled the thoughts of chemists for over a hundred years, and, though at times it has been treated disrespectfully and attempts have been made to abandon it, it is stronger today than ever. It is difficult to see how we could get along without it. It is far from perfect, but it serves its purpose admirably, and in the meantime is being perfected. It has given us a simple, intelligible language in which it is possible to tell the story of chemical changes, so that those who know the language can understand without difficulty. It is thus an aid to thought, and has no doubt by virtue of this fact been responsible for many discoveries.

We owe to Dalton the suggestion of this theory, which seems to have come to him almost as a gift from Heaven. For the facts known at that time, the beginning of the nineteenth century, were not sufficient to justify the theory. As is often the case with those whom we call geniuses, he saw far beyond the facts, and it remained for those who followed him to show that the theory is in accordance with all the known facts.

Dalton was a poor English schoolteacher, at first near Manchester and afterwards in that city. He had only the most inadequate resources for his work, and his time was largely taken up by his daily duties as a teacher. A statue has been erected to his memory in the city where he worked so long, and I am glad to be able to say that the chemical laboratory of the Johns Hopkins University, which for so many years was under my guidance, has always been known as Dalton Hall. All chemists honor this simple, modest worker, for, as the years go by, it becomes increasingly evident that chemistry owes an enormous debt to him.

Berzelius, a Swede, undertook to determine by careful analysis whether the ideas of Dalton are or are not well founded. In order to accomplish his purpose it was necessary for him to devise and improve the methods of analytical chemistry. His influence was great and he was recognized as the leader of his time. Ambitious young men who wished to study chemistry went to him from other countries. One of these, Wöhler, so long at Göttingen, has given us a charming account of the laboratory of Berzelius. It was simplicity itself. A table, a cook stove, a tub with water and the necessary bottles, and Anna, the cook, who, in addition to preparing the meals and performing the other household duties, also acted as laboratory servant—these made up the furniture.

Now I must speak of Liebig, the most influential chemist of the 19th century—a most remarkable man. His opportunities for study in early life were very poor in his native country, Germany. He was able, however, to go to Paris, where there were at that time a number of active workers in chemistry. He was received into the laboratory of Gay-Lussac. Here he continued an investigation which he had begun while still at home. His chemical curiosity had been awakened by seeing a showman make fulminating mercury and perform experiments with it. This led him to the study of substances related to cyanogen, which he continued for a number of years. At the age of 23 he was appointed professor in the University of Giessen, and proceeded at once to establish a laboratory for students of chemistry, which was the first chemical laboratory in the world open to students. Up to that time it had only been possible to gain access to the laboratories of the masters by favor. The influence of this crude laboratory at Giessen was immense. Students flocked thither from all parts of the world and many of these became leaders in their native countries, so that for many years Liebig did more than any one to advance the science of chemistry. It was he who introduced the methods of instruction which still prevail in their essential features. In his laboratory for the first time advanced students were allowed to take part in the investigations that were in progress and were thus encouraged and shown how to become investigators themselves. And many important investi-

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gations were carried out in that laboratory, but of these I cannot tell here. What I must tell, however, and it is this that I have had in mind since I began writing this article, is that Liebig is the founder of the methods which are responsible for the great progress of industrial chemistry. He taught the important truth in season and out of season that chemical industry is dependent for success upon two things: First, thorough training in the science; and second, the investigating spirit. Now the world recognizes this truth, and progress in chemical industry is rapid, though nowhere has the influence of Liebig's teachings been felt to the same extent as in Germany.

Another lesson taught by Liebig is one which, in our haste, we are apt to forget, and yet it too is of fundamental importance. It is that progress in chemistry depends upon perfect freedom of thought. If the question of utility had been raised at the begnining of those investigations which have been principally responsible for the advancement of the science, that advancement would certainly have been much slower than it has been, and it is probably safe to say that there would have been no advancement.

I am aware that this proposition will not be accepted by all. I have, in fact, been trying all my life to convince my fellow-men of its truth, and I know that in many cases—probably in most cases—I have failed, but I must make at least one more effort.

The proposition in brief is this: In order that chemistry may make progress it is absolutely necessary that investigators should not be hampered by the fateful question of what use is this work likely to be? If any one of my readers who has reached this point is inclined to stop here and make uncomplimentary remarks about the writer, let me ask him to read on. Perhaps he may acquit me of the charge of being a hopeless, foolish idealist. A very distinguished American with whom at one time I was thrown into rather close relations asked my help in making some appointments. I submitted a short list of names to him and he asked in regard to each one: "Is he a practical man?" and "Is he an idealist?" I was able to answer "Yes" to every question, for I had been careful to select men who were practical and who were also idealists. Then the questioner explained as follows: "When I ask a practical man whether the man he is recommending is an idealist, I often find he thinks I mean a d—— fool; and when I ask a thoroughgoing idealist whether the one he recommends is practical, the chances are that he thinks I mean something base." It is clear that much misapprehension exists as to the significance of the expressions "practical man" and "idealist." Now, I claim to be both. But I don't think I should be a good "practical man" if I were not something of an idealist, and I don't think I should be a good idealist if I were not practical. I hope my readers will not accuse me of being something base or adopt the alternative suggested by the remarks above quoted.

To come back to the proposition which I am defending. There is, I suppose, no question that the chemists already named in this article were great chemists and that their work was largely responsible for the earlier advances of chemistry. Let me name them again—Priestley, Scheele, Cavendish, Lavoisier, Dalton, Berzelius, Liebig. Were these practical men in the narrower sense? If by the expression is meant men who ask at every turn of what use is this likely to be, I must answer emphatically "No." Two of those in the list did undertake investigations with a direct utilitarian object. These are Liebig and Lavoisier, and it is no doubt true that some of their work of this kind was of great value, but their purely scientific work did much more to advance chemistry than their so-called practical work.

But perhaps some of you will ask, "Is the advancement of chemistry an end in itself?" I answer "No." The advancement of chemistry is of importance only in so far as it contributes to the welfare of mankind. I want to get as much out of it for humanity as possible. In order to get the best results, however, two things are to be borne in mind: First, we must get knowledge of the fundamental facts; and second as this knowledge increases the results will be felt in all the applications of chemistry. In other words, cultivate the pure science to the fullest extent. Every advance in the pure science will be felt in the applications.

Now I think I can redeem myself. You will all admit that the more thoroughly a science as such is developed the better the chances of the industries which depend upon the applications of the science. Will you also admit that the progress of a science as such is hampered by the introduction of utilitarian suggestions? I hope so. That does not end the matter by any means. So far as chemical industry is concerned it only begins it. Chemical industry has its own problems which in a sense are distinct from the fundamental problems of the science as such. They are important problems. They are difficult problems. They are interesting problems. They often call for as great intellectual power and as great experimental skill as the problems of the science as such. The difference between the two is this, that one kind of work leads to results of direct, immediate value, the other leads to results that are of indirect value. But, let me emphasize again the truth that the applications of a science are dependent upon the state of that science.

By what I have said I do not mean to imply that a science is of value only in so far as it contributes to the material needs of mankind. There are intellectual needs to be satisfied as well, and moral needs. Increased knowledge of the universe must tend to improve man in every way. But I cannot discuss this phase of the subject here.

If I have made my main contentions clear and my conclusions are accepted, what is the moral? Primarily it is that in order to do the best for our chemical industries we must encourage work in the field of pure chemistry to the fullest extent. The industries as such do not busy themselves with the problems that have no practical bearing. They have their own problems to deal with and these are difficult enough without complicating matters by bringing in the problems of the science as such. The universities must be largely responsible for the advancement of the science in the future as for many years in the past they have been and, if they are to do their best work, they must be kept free from utilitarian influences. I do not mean that industrial problems are to be rigidly excluded from the university laboratories. That would not be to the advantage of the universities or of the industries. But I do mean that the utilitarian influence must not become the controlling one. If the universities can help the industries, by all means let them help. They should be glad of the opportunity. But let it not be forgotten that their first duty is to knowledge in its broadest sense. The industries will in the end reap the benefit of all their work in so far as this work tends to enlarge the field of knowledge.

I ask for closer relations between the industries and the universities. There is, I fear, not enough hearty co-operation between them. Some of the leaders of the industries have a poor opinion of university men, and some university men steer clear of anything with the industrial tag on it. Both are wrong. Each can be helpful to the other. How, is to be determined in each case. One obvious way is for the industry to submit specific problems to the university and see what comes of it. This has been tried and is being tried with what results I am not able to say so far as this country is concerned. Another way is for the industries to engage the services of high-grade investigators—the higher the better. This way has been followed to some extent in this country and with brilliant results in a few cases.

But it is in Germany where the most striking results of bringing the industries and the universities together have been reached. The great coal-tar industry is the best illustration. When in the late 'sixties the Badische Anilin-und Soda-Fabrik was in search of a director, a brilliant scientific investigator connected with the university of Bonn was finally selected. This was Glaser who had been associated with Kekulé. Other factories followed suit and, soon after, all factories of a similar character were in charge of able scientific investigators—men who had won their spurs in the universities and not in the industries. It is undoubtedly to this fact that the rapid rise and pre-eminence of the German coal-tar industry is due.

But in another way the universities also contribute to the success of the industries in Germany. The leaders in the industries are quick to see the possibilities in the work carried out in the universities and proceed to test these possibilities and exploit them in case they continue to appear promising as the severe industrial test is applied. In this connection most wonderful fairy tales could be told. The most wonderful is the story of indigo. This has been told by Dr. Brunck of the Badische Anilin-und Soda-Fabrik in a fascinating way and his lecture has been widely read. In brief the story is this. After many years of experimental work Baeyer, then and still professor in the University of Munich, Germany, succeeded in unraveling the constitution of indigo. That was the object of his work. It is doubtful whether the thought that his discoveries might find practical application even entered his mind. Such a thought could certainly not have entered his mind during the earlier years of his work. As a matter of fact, the method devised by Baeyer for the artificial preparation of indigo has not proved successful in practice. Nevertheless, the methods that have proved successful were suggested by Baeyer's work, and they also, it should be said, are the outcome of university laboratories. But, even after the fundamental facts had been established by purely scientific work, much remained to be done before commercial success was reached. In fact, the "Badische," according to Dr. Brunick, invested between four and five million dollars in their efforts to perfect the process for the artificial preparation of indigo! And they succeeded. Natural indigo is a thing of the past. Today the needs of the world can be supplied by the German factories. The difficulty at present is that the world cannot get this important product owing to the temporary derangement of transportation facilities.

This is a beautiful illustration of the relations between science and industry. It is a direct result of the teaching of Liebig.

When I received the invitation to write an article for this number of the Manufacturers Record no subject was specified, though the suggestion was made that "The Romance of Chemistry" would be a suitable subject. I cudgeled my brain in the hope that something would occur to me that might find appropriate place under the above title, but in vain. In fact, I am at a loss even at this stage to give a title to what I have written, and yet I have said some things I wanted to say. I am informed that the number of the Manufacturers Record in which this is to appear is to be devoted to "The Chemical Potentialities of the South." Well, chemical potentialities can be realized only by adherence to correct doctrine, and I have tried to preach correct doctrine. To the leaders of the South let me say in conclusion that my long residence in a city of the South has awakened in me a lively sympathy with her problems and a desire to be of aid to the extent of my ability in solving those problems. In one way, I am conscious of having been of assistance. I have had a hand in the education of a number of the chemists holding high places in her educational institutions; and I am proud of this. Give these teachers proper facilities and good results will follow. And to those especially interested in the chemical industries of the South one word. Put yourselves in close relation with the highest chemical authorities you can reach and take their advice. Chemistry has great treasures in store for you. Seek and you will find.

Ira Remsen

The Role of Chemistry in the Industrial Development of the South.

By CHARLES H. HERTY, Ph.D., President of the American Chemical Society.

SURELY we must all take it as a harbinger of better days when a great journal, such as the Manufacturers Record, throws its whole energy into the preparation of a special issue which shall serve to bring closer together chemistry and the South. Identified with that section throughout my life, and loving it as I do, my heart gladdens with the thought that this new agency of public arousal has enlisted, with its accustomed vigor and clarity of thought, in the campaign whose success has such deep significance for the full realization of the remarkable potentialities of the South.

CHARLES HOLMES HERTY, Ph.B., Ph.D.

This campaign is not merely the endeavor to develop certain lines of chemcial industry which would utilize certain raw materials found in abundance in the Southern States; it is rather an effort to convince the industrial leaders of the South that in all their thoughts of future development they should recognize chemistry as the first and most vitalizing aid, should consult the chemist as readily as the lawyer, the engineer or the geologist, and should realize that, since chemistry has essentially to deal with transformations of matter, therefore, it is along lines chemical that the clear road leads to the highest industrial development. In other words, to make chemistry an integral part of the thought of the South.

The question naturally arises: "How is chemistry to be thought of in our work-a-day life?"

I would suggest three viewpoints:

First—Qualitative.

Second—Quantitative.

Third—Research.

These are mentioned in the natural order of their increasing importance. Let me discuss them with explanations and illustrations.

QUALITATIVE.

In this respect we have long made use of the chemist. The old question, "What's in this?" is familiar to us all. A new material, a drinking water, and what not, arouses legitimate curiosity as to its components, and the answer by the chemist may at once determine the possible future usefulness of the product and the general lines in which it may prove of value. This, however, is elementary and does not carry us very far. We get on higher ground when we approach the next phase of chemical usefulness, and that is

QUANTITATIVE.

An ore may contain gold, but that has no industrial significance until we know how much of the precious metal it will assay per ton of ore. A fertilizer may contain nitrogen, phosphoric acid and potash, but the farmer wishes to know how much of each is present in order that he may know if his purchase meets the guarantee printed on the sack. By quantitative analysis the chemist gives definite knowledge of the amounts of constituents present. The demand for such knowledge is widespread among us, and so we find many technical laboratories engaged in answering such questions. Indeed so necessary is this knowledge that we find the several States each in the possession of chemical laboratories where the public is protected by quantitative analysis from fraud through the adulteration of foods, false measures in fertilizers, danger in drinking water and in illuminating oil, etc.

Another important application of the quantitative side of chemistry is in the control of manufacturing operations. At Ensley, Ala., pig-iron is drawn from a blast furnace; immediately a sample is rushed to the laboratory, the percentage of certain important constituents determined and the results reach the steel plant at the same time with the shifting engine drawing the crucible of melted iron. Again, in the cottonseed-oil mill the per cent. of oil in the hulls is determined, and from this fact information is gained of the efficiency of the separation of the meats from the hulls, and by analysis of the meats and cake control is had of the press work in the mill.

Such cases illustrate in manufacturing processes the substitution of accurate knowledge for the "thar or thar abouts" method which so long prevailed in general and still persists in many industries. We are making progress, however, in this line and thereby becoming more and more efficient. Wherever accurate record is kept of the quantitative composition of intermediate products faulty details in the process of manufacture can be quickly located, the correction applied and the result is improved final product either in quality or quantity, or in both. So often at annual meetings we wonder where the dividends are, oblivious of the little leaks here and there which quantitative analysis could so easily detect and which corrected would change loss to profit.

Before leaving this side of the subject let me comment on one feature of the present day situation among our larger manufacturing concerns which is passing strange, and that is the failure to make use of chemistry in the purchase of supplies. As an illustration, take our textile mills. If the Southern textile mill chemists were to try to organize a subdivision of the American Chemical Society at the approaching meeting in New York City in September, I am sure there would not begin to be enough members to fill the very limited number of offices of such a division, and yet if figures were available of the total value of supplies purchased by the mills of the South, such figures would be astounding. Coal, lubricating oil, starch, bleach, dyestuffs, mordants, paints, etc., all (excepting dyestuffs for the present) susceptible of purchase on specifications and in nearly all cases purchased solely on experience with a definite brand, on the glibness of a salesman's talk, or on confidence in the firm from whom purchase is made. I do not mean to impute bad motives to such sellers, but frequently products from the same firm vary, errors are made by shipping clerks, and in a number of ways, all in good faith, we may fail to get what we think we are buying. However it may come about, quantitative chemistry is the best insurance against such shortcomings in the products we buy.

"But," says some mill owner in reply to this, "my business is not large enough to justify fitting up a laboratory and paying the salary of a chemist." He may be correct in this, but I would urge him, before deciding this point, to look carefully over his expenditures for supplies last year and see how much insurance he considers it worth to be certain that he has received what he thought he was buying. If then he still feels that "the game is not worth the candle," why not join hands with several nearby mills and organize a co-operative or joint laboratory? A brief experience with such a laboratory will, I am confident, convince each mill owner that a chemical laboratory is an indispensable feature of his mill organization. More and more questions connected with mill operation will be referred to that laboratory and greater and greater efficiency will be attained.

Moreover, the control of purchase of supplies effected by such a laboratory acts also in the nature of "preventive medicine." Some time ago North Carolina, for the safety of its citizens, drafted specifications for all kerosene shipped into the State, and added to the force of the State Chemist sufficient chemists to ascertain the facts as to whether these specifications were being met by the shippers. At first many defective lots were found, but the reports from year to year show marked improvement in the quality of the oils—the chemical laboratory stands on guard and it is known to the outside world.

It is, however, the third viewpoint of chemistry in which we are most lacking and which, therefore, I wish chiefly to emphasize at this time, and that is

RESEARCH.

The term is used by many people with many different meanings as to its application, but it is used here in its broadest possible significance. What is the rôle of chemical research in the industrial development of the South? So many answers to this question at once suggest themselves that only a few typical lines can be discussed if this article is to be kept within reasonable limits.

Chemical Surveys.—(1) Through systematic chemical surveys of each section of the South facts will be developed which, when brought together and considered in their entirety, will enable wise chemical advice as to the character of chemical industries best adapted to the region in question. Mr. Charles Catlett, in a late issue of the Manufacturers Record, is absolutely right when he says:

"If a similar effort were made throughout the South to develop in each locality those things for which that locality was specially adapted, it would bring about quickly a very astounding growth in chemical industries which otherwise would be very slow in coming to the South."

That statement is simply plain common-sense; it sounds almost like a truism, yet failure to be guided by this principle was responsible for the failure of the blast furnace in operation at one time at Greensboro, N. C.

Such chemical surveys as are here recommended should bear none of the ear-marks of the "promoter," but should be carried out in the true spirit of research, which is essentially the search for truth. Only on such solid foundations can a permanent chemical industry be developed.

For carrying out these surveys two agencies naturally suggest themselves—the State governments and the railroads.

The laboratories of the State chemists should be greatly enlarged, both in personnel and in equipment, so that such surveys could be systematically carried out. In addition to the present valuable "police work," as a State chemist once termed it to me, such laboratories should become the fountain-

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heads of knowledge and stimulation for the development of chemical industries. Much data already exists, but it is disconnected and has generally been put forward as an adjunct to some other movement.

The railroads have a very direct interest in accurate surveys of the territory tributary to their lines. The creation of logical chemical industries along their lines will change raw material now unused or under low freight tariff classification to "new business" or to products naturally paying higher freights. Can they not through their chemists place facts in the hands of the chemist called upon to advise the capitalist seeking to develop such industries? The simple facts in themselves are not always determinative; often the interrelation of such facts shows possibilities not otherwise dreamed of.

To use the term "their chemists" in connection with the railroads of the South suggests at least the presence of a large number of such chemists. Is this the case? As an answer to this question let me suggest to the presidents of our Southern railroads that they look over their lists of employes and see how many chemists are in their service and what pay is given them; then let each president take a few hours off and visit the railroad chemical laboratory, if there is one; inspect the physical equipment of the laboratory, note the kind of work required of his chemists, and then take a little while longer off to reflect over the question of whether his railroad is making the greatest possible use of chemistry in the development of the potentialities of the territory covered. If that program is carried out I know what the result will be. If perchance I am wrong as to his decision, let him consult the officials of the Canadian Pacific Railway as to what they are doing today through expert chemical aid.

Transformation of Raw Material.—(2) It is through chemical research that new paths must be blazed for transforming raw material into more useful and valuable products.

The change of the linters from our cottonseed-oil mills to the guncotton now in such deadly use on the battlefields of Europe involves a long story in chemical research, and when we realize the close relationship between the artilleryman's guncotton, the surgeon's and the photographer's collodion, the collar-maker's celluloid and the merchant's artificial silk, we begin to get some idea of the possibilities still ahead for this great Southern staple.

The bauxite of Georgia and Arkansas had but little commercial value until it was brought under the spell of the magic electric furnace, and even here results were not obtained until Hall, through his careful research, found that melted cryolite was a solvent for the bauxite, and that from such a solution the metal aluminum could readily be obtained by the electric current.

The French chemist, Sabatier, through his research on the use of nickel as a catalyst for the addition of hydrogen to unsaturated compounds, provided the method for changing our liquid cottonseed oil into semi-solid lard.

The story of dyestuffs from coal-tar, so familiar to all now as to need no discussion here, is one long chapter of patient chemical research.

Such illustrations could be multiplied indefinitely. It is unnecessary to recount more to demonstrate the wonderful transforming power of chemistry on raw material, a power which results not from haphazard effort, but from an intense application of the methods of research.

In this connection I have often wondered why the naval stores interests of the South do not make greater use of chemistry in seeking to transform their crude products. Spirits of turpentine is the cheapest volatile oil in the world, and so in rosin we have the cheapest organic acid. Are not these capable of higher transformation? Chemical research alone can answer that question. So, too, cottonseed meal furnishes the cheapest protein in the world. Must these things always remain so? Must we always remain producers of cheap products while the world outside is elevating these to planes of higher usefulness to humanity? This is a serious question which deserves earnest consideration by the men who direct our various industries. My only plea is that in such considerations more emphasis be given to the possibilities that lie through utilization of chemical research.

Greater Output.—(3) Few plants operate under ideal conditions. We find, for instance, that in a given plant an 80 per cent. efficiency is realized and we rest content—as if that 80 per cent. limit had been decreed by nature's laws. Why not go after the other 20? Perhaps the temperature, the concentration, the pressure or some combination of these is not correct. Let us not guess, when the methods of research will inevitably lead us to the right solution of the problem. Splendid work in these lines is going on today in American laboratories, especially in connection with coal-tar dyestuffs, and I am confident there are going to be some genuine surprises in this industry if Congress will ever forget politics and develop a genuine feeling of co-operation with the American dyestuff manufacturer.

New Methods.—(4) In our inventories of natural resources there is always a discard into which is thrown those materials which it is not commercially profitable to work. That is good business in one sense; but it is poor business if we rest content with leaving the matter thus, for then such decision rests upon the false hypothesis that we have reached the limit of knowledge. We can well afford, in our industrial life, to imitate the "bridge" players and introduce the feature of "nullos" by which the poorest hand becomes the best when properly played. With such industrial "nullo" material it is the chemist who must play the hand, discovering new methods of utilizing low-grade material.

The "forty-niner," with his search for gold nuggets, would stand aghast could he know the volume of gold which is yearly added to the world's store by the cyanide process of extraction from low-grade material. A revolution is now in progress in western metallurgy through the flotation process of concentrating ores. Rest assured the end has not yet been reached. So let us not turn with contempt from such God-given low-grade material, but rather recognize in it simply the limitations of our present-day knowledge.

Syntheses.—(5) The most fascinating chapter in chemical research is the production in the laboratory of complex natural products; for example, synthetic indigo from coal-tar products. Twenty years of continuous research in von Baeyer's laboratory in Munich were necessary to accomplish the synthesis of indigo. Even then the work was not finished, for ten years more were required for Heumann to announce his method of synthesis which ultimately enabled the chemical manufacturer to drive the natural product from the market.

The possibilities are unlimited that lie ahead for building up substances which the world needs, and values accordingly, from simple and in many cases waste products. For such work, however, scientific attainment and skill of the highest order, the best of equipment and infinite patience are required. May not we of the South look forward to our share of triumphs in this field? Surely we have no right to negative this question; we cannot be willing to face a future of "doing the chores."

Suggestions.—If, as I have tried to point out, chemical research is so valuable an aid to full industrial equipment, how can we make it our own? The answer is simple—spend money for it. To reach their maximum service such research laboratories should be thoroughly equipped and manned by the best chemists it is possible to secure. This means considerable expense, but it is an investment which yields rich returns. Growth along this line is very rapid in other sections of this country. The example of Germany in this respect has convinced the world that through such media lie the possibilities of greater industrial development.

Let me close this article with a suggestion to a specific industry, the great lumber industry of the South. A few weeks ago I visited, while in Washington, D. C., the co-operative research laboratory of the National Canners' Association at Eighteenth and H streets, at the head of which is Dr. W. D. Bigelow. He showed me the splendid equipment, the many lines of experimental work under way, the new problems constantly arising and the fine influence which the existence of the laboratory had exerted. As I left the building the thought came to me, "What a great thing it would be for the South if the lumbermen would join hands in creating a co-operative research laboratory where the many problems connected with the chemistry of cellulose might be attacked by the ablest of the world's chemists."

The chemistry of this complex substance is still in its infancy; the problems ahead are multitudinous. The day is coming when it is going to be very expensive to use wood as a building material, for the hand of the chemist is going to transform it into other products of higher value.

Think over the proposition seriously, gentlemen of the several sawmill and lumber associations. You handle enormous quantities of the raw material daily.

The lumberman's case is simply a type. The same possibilities present themselves to all of the organized industries of the South. We do not hesitate to spend money to extend the markets for our products. It is equally important to create new industries which utilize these products and thereby enhance their value through increased demand. For such purposes the role of chemistry is all-important. Hasten the day when such developments will be found on every hand!

Chas. H. Herty.

Need of Chemical Plants South, in Times of Peace As Well As War.

DR. JOSEPH HYDE PRATT, State Geologist, Chapel Hill, N. C.

I CANNOT express too strongly the feeling that I have of the very great need of the development of the iron and steel industries and certain of the chemical industries in the Southern States. At the present time, the larger portion of our iron and steel plants, ammunition plants and chemical plants are concentrated in the Northeastern States. Many of these plants are close to the Atlantic sea border. From the standpoint of "National Preparedness," I firmly believe that we should make every endeavor to develop these industries in other sections of our country. The South, with its many and varied natural resources, with its easy communication with all other parts of the country and its favorable location for manufacturing plants, which would be practically safe from an enemy's army, should do everything possible to develop many of these industries.

With a practically unlimited source of supply of iron ore, coal and limestone, the South is able to support a steel plant equal to any in this country.

When it is considered that a considerable percentage of the dyes that are imported or manufactured in this country are used in the Southern mills, it makes the question of the establishment of dye manufacturing plants a very interesting one to the South. On the other hand, when it is considered and realized that a plant manufacturing dyes can within five days be changed into a plant to turn out explosives, and that the first steps in the manufacture of dyes are the same as in the manufacture of explosives, it makes the establishment of dye manufacturing plants a very important part of the development of any plan for natural preparedness. These dye plants could be located sufficiently inland from the coast to make them practically safe from an attacking enemy.

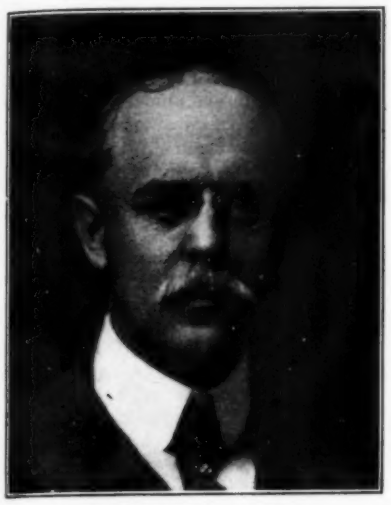
There is perhaps no better location for the erection of the nitrate plant authorized by Congress than in the South, where all the requirements of the War Department regarding location can be met.

I am not advancing these ideas simply from the standpoint of natural preparedness, but believe that such manufacturing plants as I have mentioned can be made profitable investments, and can in time of war be utilized at once in the manufacture of munitions of war.

The Synthesis of Southern Wealth.

By Dr. Arthur D. Little, Former President American Chemical Society.

IN Norway they have a natural resource known elsewhere as the atmosphere. By the aid of brains and water-power the Norwegians convert it into nitric acid, which is a merchantable commodity just now in great demand. In so doing, they effect the synthesis of wealth.



DR. ARTHUR D. LITTLE.

The atmosphere was there when Norway was a poor and savage country. It has been there even longer than the Norwegians. It has only recently become a source of wealth. What has brought about the transformation? It has come through the reaction upon the atmosphere of personal initiative, science and capital. If these three agencies working in co-operative harmony can snatch wealth from the air in Norway, what may we not reasonably expect of them when applied intensively to the natural resources of the South?

The opening of the Second National Chemical Exposition in New York is an event of unusual significance and importance in the industrial development of the United States, and to no section of our country should it carry a message of deeper meaning than to the South. A cataclysm involving half the world has deprived us of many raw materials and finished products, stimulated beyond precedent many lines of manufacture, forced our industries into new channels and, most significant of all, given an enormous impetus to industrial research and applied science. As a consequence the country is entering upon a new era of industrial development, an era destined to be signalized by a vast extension of industries based on chemistry. The general trend of this development, its immediate objectives and first results will be strikingly evident in the National Chemical Exposition.

The time is therefore peculiarly opportune, as the Manufacturers Record has perceived, for urging once more upon the attention of capitalists and manufacturers North and South the extraordinary variety and range of opportunity for industrial development existing in the Southern States. Farm products exceeding $3,500,000,000 in value are convincing evidence of the potentialities of Southern agriculture; products worth nearly $4,000,000,000 annually attest the range and volume of southern manufactures, **but the world has yet to learn that no region on earth can compare with the Southern States as a locus for chemical industries.**

It has long been the habit, which we shall soon outgrow, to refer all things chemical to German standards. Let it now be remembered that Texas alone has an area greater by 55,000 square miles than Germany; that the forests of the South cover 259,000,000 acres, as against 35,000,000 acres for Germany; that southern coal fields are more than 50 times greater than the coal areas of Germany, and southern deposits of iron ores incomparably more extensive. Water-power is essential for electrochemical and electrometallurgical developments. The South offers 5,000,000 horse-power. Cotton is the basis of smokeless powder, celluloid, collodion, artificial leather, photographic films, vulcanized fiber, parchment paper, carbon filaments, certain forms of artificial silk, cellit, cellulose acetate, aeroplane varnishes, lacquers and many other chemical products. Cottonseed oil plus hydrogen yields an edible fat of attractive quality and high food value. Germany, of course, produces no cotton.

All the basic raw materials for a highly diversified chemical industry conducted on a scale of magnitude which could supply the world are available in superabundance in the South. For fuels it offers coal, petroleum, natural gas and wood waste; for heavy chemicals, sulphur, salt, pyrites, lime; for dyes, synthetic drugs and high explosives, the distillation products of its coke ovens: for paper-making, the cheapest pulp wood in the world; for aluminum, bauxite; clays for Portland cement, pottery and terra-cotta; fuller's earth for refining oils; copper, zinc, lead, manganese and other metals for special alloys, and for ethyl alcohol and ether, wood waste almost beyond measure.

For those who think only in figures the statistics to prove the thesis are readily at hand. Everyone who has studied the South knows these resources to be available in abundance far beyond the ability of the next few generations to utilize wisely and efficiently. The problem of the present and immediate future is to check the reckless, indiscriminate, blind waste which even now jeopardizes the prosperity of our descendants and to proceed in an orderly, organized, far-seeing way to develop and make actual as much as possible of this potential wealth.

As the presence of countless tons of air pressing upon the soil of Norway did not of itself suffice to determine the production of nitric acid in that country, so also in the South will the mere abundance of the raw materials for great chemical industries fail to secure their establishments. As in Norway, the synthesis of southern wealth demands the combination of personal initiative, science and capital. In this endeavor the science most directly and fundamentally concerned is chemistry. The key to the synthesis is therefore intensive, well directed, industrial research, backed by capital and in close touch with local interests. Some classes of this work might very properly and to great advantage be undertaken by the scientific bureaus of the Federal Government, which have already contributed so greatly to the agricultural and industrial development of the entire country. The limitations under which these bureaus necessarily work, however, as regards the commercial exploitation of their findings makes it desirable, if not indeed imperative, to depend in probably the larger measure upon private and corporate support for the necessary research.

Much of the development in question will naturally be initiated by the particular interests now engaged in special lines of industry in the South or elsewhere. So far as it may go, this is a logical and most desirable procedure. It fails, however, to meet all the requirements of the situation. A broader initiative is needed.

The great railroads of the South are pre-eminently interested in the development of the natural resources of the territory which they serve. Each new industry established means new freight, and sometimes a great deal of it. The railroads are therefore a logical, if not indeed the logical, and most direct agency for inaugurating and fostering the industrial research which should constitute the initial stage of such industrial development.

Many American manufacturing corporations find it profitable to expend large sums in supporting industrial research within relatively narrow fields. If the railroads of the South would spend as much as one of these corporations in supporting industrial research designed to attract new chemical industries along their lines, the benefits to the South would be incalculable, and the return to the roads in freight receipts would soon amply justify the expenditure. The initial duty of such an industrial research organization would be to study and prepare a descriptive index of the natural resources of the territory served by the railroad. Concurrently with such study the oganization should point out and demonstrate methods for the profitable utilization of these resources and ultimately place before local and other capitalists concrete and well-considered plans for specific developments.

The work of the research organization would be greatly facilitated, and at the same time rendered far more effective than could otherwise be the case by its direct connection with the railroad. The railroad could often supply immediately much of the data required for a solution of the economics of a given situation, and in its intimate knowledge of the communities within its territory would go far toward simplifying the all-important human factor in each proposition.

While primarily intended for constructive service, the research organization would fail in its full duty did it not from time to time as occasion might arise point out the fallacies involved in unsound projects seeking local financial support. To take a present instance: Great publicity has recently been given to an alleged "discovery," reported from Germany, that paper can be made from cotton stalks. Of course it can. Paper of a sort can be made from practically any vegetable raw material. The essential question is, "Is it worth while to make it?" The answer depends upon the quality of the paper produced and the relative cost of production. In the case of cotton-stalk paper, the answer is an emphatic "No." Papers have been made from cotton stalks in this country at intervals for years. The fiber of the stalk is, however, so short that the paper has comparatively little strength, and the presence of bark, bolls and seed hulls makes it very difficult to produce a clean sheet. The stalks are very bulky, so that digestion costs are unduly high and the yield per digester relatively low. A mill of 100 tons daily capacity would require at least 75,000 tons of air-dry stalks per year. Why should one trouble to collect and store such a quantity of a bulky, inferior raw material and use it to make poor paper when he can buy, delivered at his mill, yellow pine pulp wood at $2.75 a cord and make a high-grade paper at a cost for wood of $4.13 per ton of product? If we ignore the quality of product, which is, in fact, determinative, and compare the two raw materials on the basis of yield alone, the cotton stalks would have to be delivered at the mill for $1.65 per ton, which, in view of the necessary radius of collection, is in itself prohibitive.

Returning to the constructive aspect of our subject, let us consider briefly in conclusion what might reasonably be accomplished in the synthesis of wealth from a single Southern raw material now classified as waste.

As I have repeatedly pointed out, only about one-third of the average yellow pine tree reaches the market as a merchantable product. Two-thirds of the tree is wasted, either as field waste or mill waste, in the best present practice. For 15,000,000,000 feet board measure that goes to market annually, 30,000,000 feet are wasted. It is a staggering total. It may be said at once, without fear of successful contradiction, that the potential profits in this waste are far greater than any actual profits which this branch of the lumber industry can be made to yield from lumber. **When this waste is intelligently considered, not as waste, but as raw material, it will be seen to afford a basis for building up the greatest group of correlated by-product industries the world has ever seen. The products of these industries will comprise wood pulp, pulp boards, paper, paper bags, paper twine, turpentine, rosin, pine oil, charcoal, tar, ethyl alcohol, cattle feed, varnishes, ether, and not improbably acetic acid, wood alcohol, acetone and producer gas.**

Whereas $3 is a fair average profit on 1000 feet of yellow pine lumber, the profit today on one ton of kraft paper, requiring for its production only a cord and a half of yellow pine "waste," should not be less than $100 in a well-designed and managed mill. In a mill making only 50 tons a day, that would seem to constitute a fairly efficient synthesis of wealth.

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The Undeveloped Powers of the South.

By W. R. WHITNEY, Ph.D., Research Laboratory, General Electric Co., Schenectady, N. Y.

THE industrial resources and opportunities of the South were quite comprehensively treated by Dr. A. D. Little in an address before the American Chemical Society at New Orleans in April, 1915. I shall not attempt to repeat even a small part of the valuable impression his paper produced. He based his encouragement upon statistics and he showed the rapid recent growth of the South in manufactures and in the production of such materials as sulphur, phosphates, ores, cement, rosin, turpentine, etc. He practically showed that the raw materials of the South need to be further submitted to what we call "development expense," mixed with more thought or combined with more visions. It seems as though the country was really in need of more chemical study. With all the modesty to be expected from one of the clan, we are forced to conclude that the South needs more chemists. It needs a few who have time and opportunity to study carefully in laboratories the raw materials of the country. The chemists of other States are very much occupied with the problems of their own neighborhood, and realize the inefficiency connected with studies at a distance. Our American Chemical Society has about as many members living entirely outside of America as it has in our Southern States, and there are almost as many in several single Northern States as in all the Southern States together.

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Naturally, the chemists at work in any given territory are as much the cause of their being there as they are the effect. Some chemist may show how cheap motor fuel can be made from scrap pine or rosin, and then the increase in the density of chemical population will rise in proportion to his success. I think it may also be shown that the industries grouped around Niagara Falls and now strangling for want of more power are as much the result of the power plants installed there as they were the cause of those plants. Those industries came into existence because electric power was made cheaply available there. No one of those particular captains of electrochemical industry, as I recall them, would have postponed his visions or held up his experiments and his developments while some water-power site was being discussed or prepared, but cheap power was his guiding star. The power was available and the experiments, where these were necessary, were often done at Niagara.

One naturally turns to water-power for electrochemical processes, and as the South apparently has a great deal of undeveloped water-power, it is natural to think of combining her needs for electrochemical products with her possibilities of cheap power. We may assume that there are about 5,000,000 undeveloped horse-power in the waters of the South. This is about ten times that developed at Niagara Falls and nearly equals all that has been developed in the country at present. Thus it is probable that mechanical energy is available in the South and that the paucity is in mental energy or engineering. The fact that most of the manufacturers at Niagara are now complaining from insufficient power makes it seem possible that further water-power developments, particularly in the East and South, are needed, and the South has at least one of the greatest undeveloped power sites of the country.

It cannot be expected that water-power, even at maximum possible development, will displace steam power, but in so far as it is used, it is conserving our coal, oil and gas, which in any analysis differs from the water-power in being lost to the country when used, while the water-power is only lost when it is not used.

To one who has not made a careful study of Southern conditions, it would seem that the policy of selling to foreign countries the raw products, such as phosphates, cotton, turpentine, rosin, etc., could be improved upon by turning such products into still more valuable materials by means of local energy and enterprise. The results of the extensions of cotton and steel mills have already become well recognized.

In the case of the South we are naturally led directly to the fertilizer problem, and this can hardly be justly touched upon without reference to some of the proposed processes for manufacture of fertilizers in the South. It is generally understood that with cheap power several forms of fertilizers needed in the South could be economically produced, just as in other countries they are so produced. It is also known that they have not been economically produced anywhere except by use of water-power. The various processes for fixation of nitrogen from the air seem particularly promising in the Southern States, where a market for fertilizers is already at hand. It would seem a wise thing to encourage the commercial experiment of erecting a sufficiently large fixation plant to test its value to the South. If it were found that fertilizer-nitrogen thus made under local conditions could compete successfully with fixed nitrogen from other sources, the value to the South might be very great indeed. Any considerable improvements in the present processes would certainly assure this end, though those most familiar with the subject believe that improvements are unnecessary. The one difficulty seems to be a suitable grant of water-power privilege to companies which have sufficient capital and the electrochemical process necessary for fixing the nitrogen. Each of these limitations is real, and must be borne in mind.

From the chemist's standpoint, at least, a process such as that of the Cyanamid Company, whereby a combination of fixed nitrogen as ammonia and of phosphate in a highly concentrated form is made, seems a great step in the right direction and would fit in well with the phosphate rock supply of the South. Fertilizers are by their nature and of necessity cheap products. Cheap products suffer relatively from cost of shipment and transport, and it is important that the concentration of such products be as great as is possible. Yet our average American fertilizers are mixtures containing only a small amount of the necessary plant foods diluted with a large quantity of earthy material. The cost of shipping this chemically useless material is very great, and so to the chemist a pure, dry plant food, such as an ammonia, lime and phosphate compound, seems attractive.

As has been pointed out by Washburn (Jl. Amer. Electrochem. Soc. 27, 389, 1915), in the South where the roads are particularly bad in spring when fertilizers are most desirable, the labor of getting the requisite quantity of fertilizer from the depot to the farm would be reduced to about one-sixth of the present cost, if highly concentrated fertilizers could be used, and the freight cost from the source of supply to the depot should be correspondingly reduced. Producers of the present types of mixed fertilizers, which run from 80 to 90 per cent. chemically useless material, point out that the farmer could not be depended upon to properly use pure fertilizers, because of the difficulty of application, dilution and mixing with the soil, and that the sale of ready mixed or diluted product is therefore warranted, even at its additional cost in freight and labor.

This seems to be an experiment the cotton-growers should try. With the acute powers of the farmer for observing the effects of his efforts and the community intercourse common in our land, it is hard to believe that the process of getting into the soil the right concentration of good fertilizing chemicals would long bother the farmer if he had the materials at hand cheap enough to warrant the trial. For such reasons it seems as though some wise plan of aiding the development of water-power sufficient for the Southern fertilizer needs is worth considerable thought. The difficulties probably lie in the unfairness possibly produced by aiding one group of manufacturers of a product which other groups are also producing.

It is common to assume that the production of any nitrogen fertilizer product in addition to that now produced would so reduce the price as to injure the interests of those who for example are now actively engaged in recovering ammonia from gas liquors and coke ovens. There is probably no advantage in robbing Peter to pay Paul, and unless the new fertilizer processes could exist and compete without abnormal support there are economical hindrances as determining as the laws of survival in case of living organisms. This makes it seem desirable that attention be continually attracted to the possibilities of fertilizer production in the South and to the factors determining the value of different processes, in the hope that Southern capital may itself develop the industry. Water-power rights or power supply permitted equally freely to all industries under conditions that would insure the utilization of an appreciable fraction of the power available seems a step in the right direction.

I do not wish to confine my thoughts to what has been done, nor yet to those clearly worth while things which are now well under way or already imbued with sufficient vis viva, so that mere words are not helpful. I want to point out the possibilities which more effort, more visionary attempts may realize. Of the chemists of the country only a very small number are at work on new products and processes. The most of them are aiding in some way in the production of established products of all sorts, from ores to foods. These should not be solely depended on for help to the South. They are preoccupied. The way to start doing a thing is to start at the beginning. If a dozen good chemists and chemical engineers were turned loose on the possibilities of the South, something would have to come of it. The fact that the Canadian Pacific Railway is employing the A. D. Little Chemical Corporation to study possibilities in Canada might suggest the thought of some such plan for the South. But from the larger American point of view this would be merely well deflected but not new energy. The South should produce more chemists, electro-chemists and engineers, and should interest them in local problems.

I think that even before the present war most chemists were ready to accept news of a commercial process for making artificial rubber. This might have used the turpentines of the Southern States for raw material. Would it not be better to have our own chemists studying such problems than to supply the raw material for others abroad? Resin, of which the South supplies such large quantities, may possibly be capable of inexpensive chemical modifica-

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tion, so as to be a perfectly satisfactory varnish base. Experiment alone can decide.

The South has for years shipped its highest grade phosphate abroad and used its lower grades at home. Why are the foreigners so favored? Because they know how to make the phosphates better worth while than we do. It seems highly probably that suitable research would develop processes by which the phosphorus could be put into more useful and economical shape for us than in the raw rock now used.

But always back of such experiments must be found the men, the students of things. An experimenting laboratory connected with a college or university of the South is a thousand times as likely to do useful research work on cellulose, turpentine, etc., as are men who are working in other surroundings. The university laboratories of some of our Western States are highly active in mining and metallurgical problems, but they will probably not directly help the South to develop her natural resources. The young chemist who is most likely to do this is he who has watched cotton grow or fail to grow or has played about a turpentine still, or whose father owns a prosphate bed or leases a monazite deposit.

For such reasons, we would prefer to see the South invest more extensively in her young men. Give them the engineering and scientific education more commonly granted to boys of the rest of the country.

We leave to others the duty of pointing out the value of education in general to any part of a country, and want to call attention here only to the possible value to the Southern industry of higher scientific education. As a part of that education we would like to see study of the economic and engineering possibilities of the South. The water-power sites will then become better known and appreciated. The number of productive processes will increase and the proportion of new products peculiar to that section will be augmented.

It is not difficult to find indications of the relative activity of various parts of the country in the study which must precede new processes of production. In the United States in 1914 there were conferred in 46 teaching institutions for graduate work 519 degrees of Ph.D. Thirty of these were at Johns Hopkins University and only six in the other Southern States. The central Southern States hold about 20 per cent. of our population, but educate to the degree indicated, only about 7 per cent. of those who were so educated in the country. The other 93 per cent. obtained their degrees and did their work in Northern or Western institutions.

The extent of grants for scientific research in different parts of the country points again to the need of greater interest in the South. Of funds, fellowships, etc., for scientific research as listed by Professor Cross in Science, 1916, not including medical research and without substantial limitations as to the residence or institutional relations of the grantee, there are 28 grants. These range from a few hundred dollars to the twenty-two-million-dollar Carnegie endowment, but outside of Washington, D. C., there are none from Southern States.

For medical research in the United States there are 32 grants, only one of which is in a Southern State. Of grants for scientific research chiefly in collegiate institutions, there are cited 66 in the United States, none of which are for work in the South. There are many things which explain in part these peculiar conditions, and too much weight must not be given these signs, but it seems safe to say that a way to try improving local conditions is to support better the educational efforts of the South. Upon the industrial side, it is very desirable to advance the engineering and research teaching of Southern schools.

One might almost be forgiven for claiming that the largest part of Germany's success in the chemical industries is to be attributed, not to well-laid plans for the applications of power to manufactures or to attempts to develop certain well foreseen chemical processes, but to the fact that for years she educated so many more scientists and chemists than there was any visible call for, that something had to happen. With the supply of knowledge they produced and added to the known stock, they were later able to control large special fields of chemical activity and thus to employ further supplies of trained chemists and to develop manufacturing centers of world-wide repute. The foundations of this success were laid in the education of the people, particularly in regard to a knowledge of matter. If, then, there is even a small chance for success in some such Federal enactment, as, for example, the Newlands Bill, which would appropriate $15,000 annually to the land grant colleges of the country for aid in engineering research, the South might well take interest in it as a start toward local engineering advance.

The Relation of Water Power to Crop Production.

By Frank S. Washburn, President American Cyanamid Co., Niagara Falls, Canada.

ONE pound of nitrogen in soluble form properly applied to the soil will increase the yield of wheat by one-third of a bushel. One pound of phosphoric acid (phosphorus pentoxide) likewise will increase the yield of potatoes by one-third of a bushel. The energy equivalent of a continuous electrical horse-power year will transform 1000 pounds of the inert nitrogen of the atmosphere into plant-soluble form, or applied to the production of phosphoric acid in the electric furnace will produce from phosphate rock 2000 pounds of phosphoric acid. Therefore, we may commute water-power into crop production. If applied to the fixation of atmospheric nitrogen, a continuous annual electrical horse-power will produce 330 bushels of wheat, 10 bales of cotton or 1400 bushels of potatoes, or, bearing in mind that plants as well as human beings can subsist only on a varied diet, if applied to the manufacture of a peculiar form of ammonium phosphate, a chemical combination of nitrogen and phosphoric acid, the continuous electrical annual horse-power will produce 250 bushels of wheat, 1000 bushels of potatoes or 7½ bales of cotton, and other crops correspondingly. In these facts lies the importance of water-powers to crop production.

The life and growth of plants are sustained by certain elements in the soil termed plant foods. These are chiefly nitrogen, phosphorus and potassium compounds, and as vegetation lives only upon liquid food, all must be in soluble form. These three plant foods are generally designated, respectively, as "ammonia," "prosphoric acid" and "potash." When any part of a plant is removed from the field in which it was grown, there is carried with it plant-sustaining elements abstracted from the soil, and in time the soil becomes impoverished to a degree which no longer enables it to sustain plant life, or to sustain it so poorly as to result in commercially inadequate crops.

Plant food elements in the soil are an exhaustible natural resource, the same as coal and iron ore, but, fortunately, with this difference—that man has discovered entirely practicable means of replenishing the soil with plant-food elements, while he cannot replenish the mines with coal and iron. It is, therefore, a fundamental and inexorable law of nature that if man is to continue to live upon the products of the soil, he must continually replenish it with plant-food elements, and herein lies the meaning of fertilizers.

The vast economic significance of fertilizers is accentuated by other facts of great human importance. The civilized world grows at a rate which doubles its numbers in 65 years, and it has been determined that the maximum practicable increase of available acreage for crop production is far less than this. The last census of the United States showed that in 10 years there was an increase of 21 per cent. in population and only 10 per cent. in crop production. Our exports of foodstuffs decreased enormously, and our importations practically doubled. The production of beef cattle decreased 32 per cent. as the population increased 21 per cent. We see these figures strikingly reflected in the rising cost of foodstuffs, which from 1896 to 1912 increased 80 per cent.

It is no exaggeration to say that civilization has no more important subject than that of artificial fertilizers, and so far as the United States is concerned, there is no question which in public interest presses more insistently for comprehensive treatment than the matter of encouraging the establishment of conditions under which the country may be assured of an adequate, cheap and easily-securable supply of agricultural fertilizers.

The nations of Europe have been quicker to realize the importance of fertilizers and to secure for themselves the advantages of their universal application. We may take Germany for an example, although her crop yields and consumption of fertilizers are not as great as those of Belgium. Her population is 70 per cent. that of the United States. She cultivates one-fourth of the area cultivated by the United States. She grows 95 per cent. of the food products which she consumes. Her total consumption of fertilizers is nearly double the consumption in the United States, or, compared as to average quantities per acre cultivated, she uses seven times as much per acre as the United States. The average German crop return per acre cultivated from soils which have been under cultivation for centuries as compared with the American is twice as much in wheat, one and six-tenths times as much in rye, one and three-fourths times as much in oats and two and two-tenths times as much in potatoes. In 20 years Germany, chiefly through the use of fertilizers, increased the average yield per acre as compared with the increase in America as follows: For wheat, an increase of 10 bushels in Germany, as compared with an increase of 2 bushels in the United States; for oats, 23 bushels and 4 bushels, respectively; for rye, 12 bushels and 4 bushels, respectively; for barley, 13 bushels and 2 bushels, respectively, and for potatoes, 80 bushels and 23 bushels, respectively. The average increased yield per acre of all crops was in Germany 62 bushels, as compared with 20 bushels in the United States.

With these comparisons fresh in mind one is prepared to appreciate the significance of the fact that a ton of fertilizer of a given quality costs the German farmer one-half to two-thirds of what it costs the American farmer. The German farmer's association pays normally, as nearly as can be determined, $2.45 per unit of ammonia as compared with the American cost at the farmer's nearest railway station of $4.63; and as to the unit of phosphoric acid, 60 cents as compared with 91 cents; and as to the unit of potash, 35 cents as compared with $1.34. Considering the fact that the United States has open to it the same sources of nitrogen as Germany, and that the United States has a practical world monopoly on commercial phosphate rock deposits,

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the single source of phosphoric acid, the mind is inclined to leap to the conclusion that this national burden of high-cost fertilizers is purely an artificial one, and probably involved in it are extraordinary profits somewhere along the line between the producer and the user of fertilizers. Such is not the case, however. The great fertilizer industry of the United States, with an investment in physical properties of approximately $122,000,000 and annual sales of normally $170,000,000, is conducted on a margin of profit inadequate and unsatisfactory in the light of the large fixed and working capital required, the violent seasonal fluctuations and the great operative and collection risks.

The high cost of fertilizers to the American farmer has a more serious significance than would appear from a mere comparison of costs between this country and others. Our farmers are practically precluded under present conditions from deriving profit from the use of fertilizers on cereal crops, which occupy 60 per cent. of the total cultivated acreage of the United States. Were nitrogen available to the American farmer at the normal cost to the German farmer, its application to wheat, at the normal average price for the past 10 years, namely 86 cents per bushel, would yield substantially 100 per cent. net profit on the cost of the fertilizer as compared with substantially no profit at all under present conditions. The high nitrogen cost is also laying up for future generations difficulties impossible to measure, but of the greatest importance, for the reason that the present scant application of nitrogen to crops does little more than stimulate the plant to grow a long and vigorous root system, thus enabling it the more thoroughly to exhaust the soil of its natural store of nutritive elements, and thereby we are under present conditions encouraging the evil of soil exhaustion instead of remedying it.

Specific difficulties in the fertilizer situation as it exists in the United States are comprehended in the following considerations: Farm labor in the United States is scarce and expensive, the wage rate being approximately four times as great as in Europe. Therefore, that pre-eminently labor-saving device, the agricultural fertilizer, should be delivered to the user in such form as to involve the minimum amount of farm labor in its further preparation and application. This is the principal reason for the almost universal use of the so-called "complete fertilizer," with the three plant foods of nitrogen, phosphoric acid and potash thoroughly incorporated. Our country is sparsely settled and the cultivated areas widely scattered. Our farms in large part are great distances from the places of origin and practical preparation of fertilizers, involving long rail transportation. Were the people of the United States occupying exclusively the State of Texas, the distribution of the population per square mile would be substantially the same as in Germany. Dirt roads, almost if not completely impassable at the beginning of the spring planting season, when most of the fertilizer is applied to the land, are an almost insurmountable difficulty to the farmer in the hauling of large quantities of fertilizers.

The disadvantages of these conditions are accentuated by the low-grade fertilizer commonly used by the farmer of the United States. The standard article contains approximately 12 per cent. to 15 per cent. ammonia, phosphoric acid and potash. One hundred pounds must be transported by rail and by wagon in order to give to the soil 12 to 15 pounds of useful constituents. Under such conditions the manufacture and distribution of fertilizers, even as a local industry, is handicapped by a disproportionate transportation burden, but still more serious is the fact that unless the demand for fertilizers in a zone of practicable transportation cost is sufficient to support a local fertilizer factory, or if it is far removed from the sources of fertilizer materials, that region must go without fertilizers. The raw materials commonly available to the fertilizer manufacturer are so low in grade that even were the farmer's unreasonable prejudice in favor of low-grade goods removable, it would be impracticable to prepare a concentrated plant food.

It is believed that the country in the future cannot depend for adequately increased quantities and greatly reduced prices upon the materials now used as agricultural fertilizers. These are chiefly, as for nitrogen-bearing materials, or ammoniates, cottonseed meal, sulphate of ammonia, Chilean nitrate, blood, tankage, fish scrap and cyanamid; as for phosphoric acid, acid phosphate made from phosphate rock by adding sulphuric acid thereto, and as for potash, various potash salts derived from natural deposits in Germany. Cottonseed meal is the principal source of agricultural nitrogen, and there is an enormous national waste in its use as a fertilizer, because it has greatly superior value as stock food. Its value as a fertilizer, giving each one of its constituents of nitrogen, phosphoric acid and potash, the market price of these plant foods is about $30 per ton, and as a stock food it has a value of $50 to $60. There is no hope, therefore, of its decreasing in price, but, on the other hand, it is certain, and that very quickly, to have a fully recognized value as stock food that will take it out of the practical fertilizer market. Sulphate of ammonia may for a short period decrease in price, but there are a number of agencies which will strongly and probably successfully counteract any permanently low price springing from increased production of sulphate of ammonia. Only by competition through the production of extraordinary quantities of atmospheric nitrogen compounds may we ever hope, so far as now can be foreseen, for permanently lower prices of sulphate of ammonia.

There are a number of cogent reasons for this, but the strongest confirmation of the soundness of this view comes from spokesmen of the by-product coke oven industry, the source of sulphate of ammonia, who state that the industry cannot survive prices less than those which have held as an average for the last 10 years.

Blood and tankage is in the same position as cottonseed meal, only the increase of its use as stock food and its decrease in use as a fertilizer is more marked than in the case of cottonseed meal, and is proceeding at such a rate that it is a matter now of very few years when they will cease being factors in the fertilizer market.

Chilean nitrate cannot permanently decrease in cost of production or price because of the natural conditions surrounding its occurrence and production. The deposits are confined to the great waterless deserts of Chile, and vary greatly in their degree of richness. The only successful method of separating the nitrate from the earthy materials in which it occurs is by a lixiviating process requiring great quantities of water, which must be brought great distances in pipes—a hundred miles and more. The process is inefficient, and with the rapid decrease in the richer properties the cost of production mounts higher and higher, accentuated further by increasing labor difficulties due to the extraordinary hardships which are entailed upon the laborers in carrying out this process.

The production factors in acid phosphate have all been reduced to substantially their lowest attainable point. The material is sold on a close margin. It has no undeveloped possibilities, either as to further reduction in price or as an aid by conversion or by combination with other materials to lower their cost or make them more available.

There seems to be nothing on the horizon of science to promise lower prices for potash. It seems destined for some time to come to be sold by the German producers at prices unaffected by practicable competition from other sources. It is the least important of the three plant foods, constituting normally about 20 per cent. of the farmer's fertilizer bill.

The fixation of atmospheric nitrogen is one of the great new things in the world. By its means an unlimited quantity of nitrogenous fertilizer can be produced at less than half the price now paid by the farmer. Means have been developed for making phosphoric acid, both chemically and by the way of the electric furnace, in such form as to make commercially practicable, together with the fixation of atmospheric nitrogen, the production of a very cheap absolutely stable chemical compound of ammonia and phosphoric acid, unexcelled as a crop producer; highly concentrated, the standard material running approximately 60 per cent. plant food; physically a fine granular white crystalline material, dry but dustless, and non-hygroscopic. It requires no prophetic powers to forecast that sooner or later by the fixation of atmospheric nitrogen directly and indirectly a great economic benefit will be conferred upon this country. So far as we now know and believe, the processes best adapted for the United States are by the way of the electric furnace. The possible relation of Southern water-powers to the development of this industry is, accordingly, a subjct of interest and importance.

The special adaptability of the water-powers of the Southern States to fertilizer production lies in the fact that the great bulk of the fertilizers consumed in the United States are used in the South, principally upon the cotton crop, and upon the further fact that the only phosphate rock deposits within available transportation distance to fertilizer-using regions are in the States of Tennessee and Florida, and to some extent in South Carolina.

It may not be out of place here to review the water-power characteristics of the Southern States, even although in some respects these water-powers may not be universally applicable to the manufacture of fertilizers.

The natural characteristics of the great Appalachian mountain range which occupies all but two of the Southern States east of the Mississippi River are those which account for numerous and great water-powers. The number and variety of natural resources and the climate and the soil foster industrial conditions which make feasible the useful application of these water-powers. There is copious rainfall, with good seasonal distribution; there are massive, lofty mountains, remote from the sea coast, covered densely by unbroken forests for the rain to fall upon; favorable topographical conditions making practicable impounding reservoirs along the tributaries; there is geological action so universal in effect that every great river from the Potomac on the north to the Chattahoochee on the south and the Tennessee and the Cumberland on the west, as it flows through the basal plain, comes to a place where it tumbles down over a rapidly descending bed. This marks the famous geologic "fall line" and the "shoals" of all Appalachian rivers. There is an exceptionally favorable climate which, combined with peculiar meteorological and soil conditions, seems to assure to the region a world monopoly in cotton, which in turn requires cheap and plentiful power for its fabrication. There are majestic rivers navigable almost to the mountain bases. There are timber, iron and coal in great abundance and disposed for cheap production, and everywhere the sea is close at hand to the industrial section.

If we except the shore line of the Pacific Ocean in the States of Washington and Oregon and a narrow strip along the summit line of the Sierras in California and the Cascades in Washington and Oregon, the whole of the United States west of a north and south line drawn through central Texas may be considered as arid, the greater portion of it having a mean annual rainfall of approximately 15 inches. Extending in a north and south strip 200 miles wide through central Texas, Oklahoma, Kansas, Nebraska and the Dakotas is the semi-arid region, the greater portion with a limited rainfall of less than 25 inches per annum. East of this strip extending to the Atlantic is the great humid region, within which there are greater differences of regional rainfall than exist between the different grand divisions themselves, the northern half being really semi-humid, having 30 to 40 inches rainfall, while the southeastern portion, bounded by a line extending from Galveston on the Gulf Coast north to central Arkansas, thence east to northeastern Georgia, thence northeast to southeastern Kentucky, thence east to the Atlantic Ocean, constitutes the true humid region that has 50 inches to 60 inches precipitation, while the mountainous portions of eastern Tennessee, western North Carolina and South Carolina, northeastern Georgia and northeastern Alabama, together with a narrow strip along the Gulf of Mexico, shows the extraordinary average of 60 inches to 70 inches rainfall per annum.

Even this striking superiority in rainfall does not directly convey an adequate idea of the superiority of southern water-power possibilities, for it is the volume of water which actually finds its way into the streams that determines the flow, and this may be less than 2 per cent. of the precipitation in

a region of 20 inches average rainfall and exceed 50 per cent. of the precipitation in a region of 65 inches average rainfall.

The great power streams of the South, generally speaking, are the Cumberland, Tennessee, Coosa, Tallapoosa, Chattahoochee, Ocmulgee, Oconee, Savannah, Saluda, Broad, Pee Dee, Yadkin, Neuse, Cape Fear, Wateree-Catawba, Roanoke and the James. These group themselves, naturally and by industrial requirements, into three principal power districts, which may be termed Western, Southern and Eastern. The western district, with 1,000,000 potentially available continuous horse-power, has been developed in the last four or five years to the extent of 150,000 horse-power continuous on the Tennessee and its tributaries, and on the Coosa. It lies close to the South's great iron and coal district, the seat of which is Birmingham, Ala. The southern district, with 500,000 horse-power, has been well exploited for years, and lies along the Chattahoochee from Columbus, Ga., north to Atlanta, and in a district extending well into the mountains north of Atlanta. The eastern district, with 1,500,000 horse-power, has had the greatest development. It lies largely in the favored agricultural district of South Carolina and southern North Carolina, stretching north from Columbia 200 miles. The Saluda, Broad and Wateree-Catawba are its principal sources of power.

We see in the South, therefore, a most fortuitous combination of natural advantages making for the production and utilization of a cheaply manufactured and cheaply distributed fertilizer. Nowhere else in the United States do these conditions exist. There is potential available water-power to the amount of 3,000,000 practically continuous horse-power, and unlimited deposits of phosphate rock, superior coal, cheaper than elsewhere in the United States, and remarkably pure limestone, all essential to the manufacture of high-grade fertilizers containing nitrogen and phosphoric acid. The labor market is unexcelled as to the large unvarying supply of men, and, quality considered, is the cheapest in the United States. The climate is conducive to all-year-round activity, is healthful and demands only the very minimum of fixed investment for plants and their equipment. And bordering the power streams are the farms which consume substantially 60 per cent. of the fertilizers used in the United States. Nature has showered possibilities upon the Southern States beyond every other section of the United States. Will these possibilities be converted to practical accomplishments? The answer is up to the people of the Southern States.

It is easy in the matter of water-powers to take accomplishment for granted where there exists potentiality. It is self-evident that in order to develop a water-power we must first of all have a water-power to develop. A commonly mistaken viewpoint is that the mere existence of a water-power site is a sufficient reason for its development. Water-powers have limited application. Steam power in use in the United States amounts to substantially 30,000,000 horse-power, and the developed water-power is substantially 6,000,000 horse-power; the one is five times the other. If we exclude water-powers devoted to public utility purposes and include only those in the hands of manufacturers using a thousand horse-power or more, the amount of water-power in use is believed not to exceed 1,250,000 horse-power. Hydroelectric power ventures are commonly failures. They thrive best in regions where coal is very expensive. They therefore find their profitable field in the United States beyond the Rocky Mountains and along the Pacific Coast, where coal costs per ton three to four times the cost in the eastern part of the United States.

The value of an undeveloped water-power site is analogous to the value of coal in the ground. The latter delivered to the purchaser at the mine mouth carries a price of $1.50 per ton, while its value in the ground, as evidenced by the almost universal rate of royalty, is but 10 cents per ton. Out of the public's exaggerated conception of the value of water-power sites and franchises have grown Federal legislative obstructions to the development of power, particularly as applied to certain Southern States.

So much for the point of view of the developer of water-power who proposes to transform it to electric current, transmit and distribute it. His difficulties are discouraging enough, but surmountable, because ordinarily he can find recourse in steam power at a relatively slight additional cost for the distributed electric current. But how about the manufacturer who uses electric furnaces and those in the electro-chemical industries, and those whose use of power for any purpose is so great that in order to occupy an assuredly favorable competitive position they must have it at first hand cost? For many reasons into which enter cost, limited period of contract, serious fixed obligations to pay for power in times of depression and idleness, the large power user may not dare and cannot afford to purchase power of a public utility company. Such companies serve a valuable economic purpose in supplying users of power whose demands are so moderate that it is impracticable for them to develop, own and control a water-power. Therefore, it is properly through the medium of public utility corporations that the great bulk of the water-power absorbed in the various industries can be developed and distributed. But when the public utility company intervenes in the development, ownership and control of the power required by the large independent user, it may become an undesirable middleman, serving no worthy purpose and fixing a useless burden, even greater than the middleman's profit, for all time on the consumer of the manufacturer's products.

Federal legislation, such as set forth in the various proposed substitutes for the general dam act of 1910, which have come before Congress in the past six years, will protect and foster the development of water-powers through the medium of public utility corporations, but it is not clear that the difficulties of the private developer and user can be met by any Federal legislation alone. A natural and proper provision in any such act is that before a permit shall be granted by the Secretary of War for the construction of a dam affecting navigation, the applicant must have complied with the laws of the State in which the structure is situated. The State laws on such matters have been framed for the purpose of encouraging the development of water-powers and naturally fix conditions, many of them more or less formal in their nature, with which the corporation seeking the right to develop water-power must have previously complied, such, for instance, as requiring that it shall own the abutment site at either end of any dam it proposes to construct. With quite natural foresight, the public utility corporation complies with these laws and intrenches itself at every water-power site within its competitive territory, and from which it cannot be dislodged by any private company, which, due to the large amount of power it requires, desires to or for reasons of economy must develop its own power. Public utility corporations, unless protected by something akin to a public service commission, cannot exist, as a rule, where they must meet uncontrolled competition, which in many instances would be the case if in their district power sites, potentially competitive, were left open to be taken up, developed and the power sold and distributed by others.

Therefore, in States which require of the water-power developer compliance with more or less formal provisions before he can acquire title, particularly where inexpensive of accomplishment, the late comer into the field can find no unoccupied dam sites to which he can secure title, and, theferore, no place where, under any Federal act, he can secure a permit from the Federal Government for the construction of a dam.

There is another difficulty which prevents the large private user of power from making his own water-power development. That is his legal incompetency to exercise the right of eminent domain. One acre of land at a power site or in the reservoir site held by a competitor or by anyone feeling the inducement to inordinate gain could prevent the consummation of or reduce to the vanishing point the net advantages of the proposed development.

The insurmountable obstacle at the present time to the development of Southern water-powers lies in the impossibility of securing a permit for the erection of a dam upon a navigable stream. The definition of navigability has extended to the tributaries of what is ordinarily known as a navigable stream, and structures placed across them may be considered to fall under the Federal laws now on the statute books or that may hereafter be enacted. The general Federal dam law of 1910 sets forth the qualifications necessary to entitle an applicant to a water-power permit, and is, in effect, the solemn pledge of this great Government that if any possessing these attributes make application, Congress, upon the recommendation of the Secretary of War, will grant a permit for the construction of the structures necessary to the development of power at the chosen site. Practically ever since the passage of this law Congress has been considering its revision, and pending the completion of such additional general legislation it has been unwilling to grant any permits whatsoever.

Responsibility for this condition of affairs rests chiefly, if not entirely, with certain political obstructionists calling themselves "Conservationists." By working to complete exhaustion the bogey man of a vicious "water-power trust" of fearsome mien, and by giving to a water-power permit the aspect of a franchise of enormous value, the public and the people's representatives have been generally misled.

It must be admitted that the seed of propagandist teaching against true conservation by actual development fell upon a rich soil of public prejudice against that class of men of pioneer spirit, constructive ability and of strong industrial ambition who create something of social value from raw natural resources, whether they be water-powers, mines or forests. It has been easy to fool the public not only as to the quality and economic status of such men, but as to their purpose and as to their claimed invasion of public rights. In a period of deep suspicion of any large interest or of any business carried on in a large way it has only been necessary to point one's finger at any man successfully engaged in a large and important undertaking and cry "trust" to place him and his enterprise in the category of being a great public menace. During all this time, it is true, the public has maintained in theory a high appreciation of the economic and social value of industrial development, but the public defense of capital in the development of industry often fails when it comes to a specific case where it is possible to be misled by the unknowing, the prejudiced, naturally destructive or jealous.

It is peculiarly pertinent to relate here a notable instance where by definite and specific misrepresentation on the part of the leaders of this particular political cult the United States, and the South particularly, were deprived of the very kind of industry which the country generally at the present time appreciates is absolutely necessary to national security in time of war and the greatest of economic blessings in times of peace, and to the establishment of which $20,000,000 has been appropriated lately from the National Treasury. There was introduced in the second session of the Sixty-second Congress a bill strictly in accordance with the provisions of the general dam act of 1910, granting permission to erect a dam across the Coosa River at the proposed site of Navigation Lock No. 18, two miles above Wetumpka, in the State of Alabama. The Coosa rises in the mountains of northern Georgia, and traverses a great and rich valley, finally emptying into Mobile Bay. There would be an unbroken route of water transportation from northern Georgia through the heart of Alabama to the Gulf of Mexico, a distance of 800 miles, but for the shoals and rapids about midway of the river's length, covering a distance of 140 miles and a drop of 320 feet. The people of one of the country's richest valleys, with products peculiarly suitable for water transportation, are, because of these shoals, cut off by river from the sea. The volume of flow over these rapids is reported by the United States Geological Survey to be 50 per cent. greater than that of the Mississippi River at St. Paul and greater than that of the Hudson at Albany. Navigation has been established for many years on the upper waters of the Coosa, and for many years on the Alabama River, which is the modern name for the lower Coosa. Inasmuch as even a canoe cannot pass between the upper and lower rivers, the State of Alabama and the National Government, beginning as early as 1824, have had before them frequently

for consideration the problem of establishing navigation over the central or shoal district of the river. The estimated cost of from $10,000,000 to $12,000,000 for the necessary dams and locks is prohibitory if it must be borne wholly in the interest of navigation. At the time of the introduction in Congress of the bill styled by the so-called conservationists the "iniquitous Coosa River bill," there was one dam under construction a few miles above the proposed new site designed to raise the water approximately 75 feet. The proposed new dam of somewhat greater height was to be built strictly in accordance with the Government's requirements for navigation, and to this end, together with the dam already under construction, would have provided, without expense to the Government, navigation structures costing $3,000,000. The purpose of developing the power was to produce an agricultural fertilizer like that of which the neighboring Southern States absorb 60 per cent. of all that is used in the United States. Four million dollars was available for the establishment of this plant. Federal permission was not forthcoming, the President vetoing the bill after its passage by Congress, so the industry went to Canada.

The imagination, given free rein, cannot conjure up a situation in which an applicant for the right to develop power had a stronger claim in public interest to the necessary permit. To the present date no industry of this character has found its way into the United States. In every other first-class nation it is well established. The statesmen and economists of Germany consider that her greatest single accomplishment in economic advancement in many years has been the expansion of the fixation of atmospheric nitrogen made during the period of the present war, and upon which there has been expended $100,000,000 at a time when nothing less than the most vital military and economic demands would warrant diverting money, men and thought from the direct conduct of a great war.

For years the hearts of the people of the South have been warmed by contemplation of the exceptional natural advantages of their great section; their ambitions have been stirred, and the flame of their hopes for industrial development kept burning. However, nothing commensurate with the wonderful natural advantages has been actually accomplished. An industry will not force its way into a community where public apathy or prejudice makes possible political aggressions and injustices. It is only when the human factor is right that the natural advantages can be converted to purposes profitable to all concerned. It is important that the South shall show in new and broader spirit that hospitality for which she is so justly famed and beloved.

The people of the South must turn their earnest attention to the early removal of the existing insurmountable political obstructions to the development of water-power. The first step in this direction should be taken by insisting upon practical Federal and State water-power legislation which shall give to water-power developers, the private developer and user, as well as the public utility corporation, the place to which they are entitled, namely, that of worthy industrial factors more nearly entitled to a subsidy in the exercise of their activities than to be taxed with a charge for the privilege and subjected to the risk of a limited revocable franchise.

Frank S. Washburn.

What the Chemist Means to Manufacturers.

The Mistake Individually and Nationally of Low Pay for Chemists.

By FRANCIS P. VENABLE, Ph.D., Sc.D., LL.D., Chapel Hill, N. C.

UNDOUBTEDLY there are great industrial possibilities before the South, with its abounding resources, and in the utilization of these crude materials the chemist must play a most important part.

It is with regard to the proper training of the chemist that I wish to say a few words, and these are directed chiefly to the managers of the industries whom this matter chiefly concerns.

There are three ways in which the chemist can be of service. He may control through his analyses the grading of the raw materials and the purity of the various substances used in the processes; he may oversee the general running of the processes and by his knowledge of correct chemical and physical principles detect faults and suggest improvements; lastly, his time may be spent upon research, seeking to prevent wastes, to utilize by-products and to devise new methods. The last two spheres of usefulness are to be stressed as the most important to the manufacturer. Too often he thinks that the chemist's usefulness ceases with his analytical activities, whereas the seeing eye may correct mistakes or bring about changes which will mean many thousands of dollars to the owners.

It is absolutely essential that the chemist should be thoroughly trained in his profession. A large number of chemists at present employed are insufficiently trained and can be of little service, outside of routine work, to their employers. Hence they bring about a widespread impression that they are, after all, of little service and can be in great measure dispensed with.

The day has passed when chemists could be trained to efficiency in a small institution, with one or two professors and imperfectly equipped laboratories. The experience of technical workers all over the world shows that this training requires four full years of study, mainly devoted to a thorough grounding in the various branches of chemistry, and two or three years more of advanced work if the highest form of service is to be expected. It is comparable to the training required in medicine in these days of specialization. The last three years of training are to be compared to the young physician's course in the hospitals. During these the previously gained theoretical knowledge comes into application, knowledge is co-ordinated and eyes are opened to the meaning of things.

For such training as this the department of chemistry in a college needs a teaching force of not less than 10 or 12 men, including at least four professors; also large laboratories and expensive equipment. It goes without saying that the native ability of the man is the great determining factor, but unless he has the training he will find himself greatly hampered and unable to meet the demands made upon him. For the sake of the profession as well as of the industry, I cannot impress too much the necessity for careful inquiry into all details of the training. It would prove disastrous if, in the expansion of our industries, there should come an increased demand for chemists leading to the taking up of many ill-trained and unfit workers. This would discredit the profession and bring injury and loss to the industry.

Lastly, I would point out that the cost of his professional training involves a heavy outlay of time and money on the part of the chemist, and that the right man must be one of native ability and exceptional qualifications. The best are picked men, as many fall by the wayside during the course of the training. The rewards held out before them, then, must be adequate. No wise manager would think of putting an expensive machine in the hands of a dull, untrained workman. The chemist should be the eyes of the concern, constantly on the outlook for improvements. He should be well paid. A cheap man only means failure. Unless the profession holds out for fitting remuneration the right men will not enter it. The inducements held out to them in other lines are too great.

When in Berlin, in the early spring of 1914, I noticed in the daily papers an abstract from a government report stating that there was a considerable falling off in the number of students in the German technological schools. I drew this to the attention of a journalist and told him that the wonderful success and supremacy of Germany in chemical industries were at stake. He seemed disturbed, but rather made light of my conclusions. I spoke to Dr. O. N. Witt, director of the chemical laboratories at the Technologisches Institut in Charlottenburg. He was inclined to doubt the seriousness of the situation. I also talked with some of the young chemists. **They told me that the salaries after years of preparation amounted to only some fifty dollars a month, and that it was not a living wage. I learned that young chemical and other engineers were joining a protective association or union in the effort to bring about better conditions.**

A few months before his death, in 1915, Dr. Witt published an article to reassure German manufacturers and convince them that it was not possible for England or the United States to capture their position of supremacy in the field of chemical manufactures. One of his arguments was that the young German chemists were willing to work at less than a living wage, trusting to support by their families, because of the dignity of the positions held by them, and that young Englishmen and Americans would not make this sacrifice.

That such a condition could long continue is incredible. Certainly it will be impossible after this war is over. We must be careful to make no such mistake.

Insist on the fitness of your men and you will get the right sort. Give them every encouragement for their work in the way of opportunity and equipment. Remember that industrial investigations are often very costly—too costly in most cases for educational institutions to undertake them. So little help is to be further expected from that source.

It is worse than folly to think that a man of costly education, high attainments and properly ambitious of advancement will be attracted by pay less than that given the bricklayer who helps to put up the plant. To pay them well is the wisest and best policy.

Some years ago, in the course of a conversation with the manager of a large concern having branches distributed over the country, he said that he could train his janitor to do the necessary analytical work in his business.

"Perhaps that is, true," I replied, "so far as the mechanical routine of the process is concerned, but will he understand what he is doing. Large sums of money are involved in these analyses."

Later I heard that the results gotten in the various branches failed to agree and that the chemists were trying to locate the trouble. Could the janitor-chemist aid in this search, improve his methods, know when he was wrong and why, and by any chance have the vision to see the relation of his work to the whole and suggest improvements?

A poor chemist is a costly mistake at any price. A good one must be well paid, and will prove one of the best possible investments.

Francis P. Venable

FRANCIS PRESTON VENABLE, born in Prince Edward County, Virginia, November 17, 1856. Graduated University of Virginia, 1879; studied at Bonn, 1879-80; A.M., Ph.D., Gottingen, 1881; Berlin, 1889; Sc.D., Lafayette, 1904; LL.D., University of Pennsylvania, University of Alabama, University of South Carolina, Jefferson Medical College. President, 1900-14, Professor of Chemistry, University of North Carolina; President Southern Educational Association, 1903; American Chemical Society, 1905; Southern Association of Schools and Colleges, 1909; fellow Chemical Society of London, A. A. A. S.; member Deutsche Chemische Gesellschaft, American Philosophical Society. Author "Manual of Qualitative Analysis," 1883; "Short History of Chemistry," 1894; "Development of Periodic Law," 1896; "Inorganic Chemistry According to the Periodic Law" (with James Lewis Howe), 1898; "Study of the Atom," 1904.

How to Correct the Economic Balance in the South:

Raw Materials on Which to Base Great Industries.

By JOHN C. HEBDEN, General Manager Federal Dyestuff & Chemical Corporation, Kingsport, Tenn.

I AM in receipt of your letter requesting information with reference to the chemical potentialities of the South and asking for the reasons for the location of the Federal Dyestuff and Chemical Corporation at Kingsport.

The chemical potentialities of the South have hardly been recognized except in a few exceptional instances. The mountain section, stretching from the break at the Potomac River to the Alabama border, probably contains a greater variety of mineral wealth than any other section of the globe. When you come to consider that the sources of wealth are, first, agriculture, and second, mining, you will readily admit that with such a variety of natural products the mountain section of the South would naturally be the locality in which to develop industries depending upon these products. It has been said that the source of the wealth of Great Britain is her abundant stores of coal, iron and limestone. We have an illustration of the truth of this statement in the wonderful development of the two great iron centers in our country, Pittsburgh and Birmingham.

The fact that great wealth is produced by the development of the iron industry on account of the proximity of the coal and limestone to the ore proves that other industries depending upon mineral resources can be developed best by bringing the industry to the source of supply of the raw materials. Of course, many raw materials are brought great distances on account of peculiar conditions of low freight rates and for other reasons, but if one analyzes the circumstances surrounding such industries, it will be found that the natural development would have been at the source of supply of the raw materials and that this development frequently could not take place on account of the absence of some of the materials necessary for the industry; therefore, the industry was developed by assembling raw products from great distances.

In the South, however, the necessity of going any great distance for raw products, for the development of chemical industries particularly, is unnecessary. Beginning with the great gossan lead, so-called, there stretches from the mountains in Virginia to the Georgia or Alabama line abundant stores of sulphur-bearing iron minerals and sulphur-bearing iron and copper minerals, giving abundant supply of raw materials, both for the manufacture of sulphuric acid and iron and copper.

Sulphuric acid is probably the most useful product in the chemical industry, and is the one product without which civilized man in his present state of development could hardly exist.

The chemical manufacturer in the South is able to assemble his raw materials from supplies close at hand and develop his products without the inconvenience and delays of shipments from great distances. There is an abundance of coal of the highest quality and an abundance of cannel coal; therefore, a supply of coke completes the list of fuels required for a chemical industry. These fuels can be procured at prices lower than in any other section of the country.

There is an abundance of hardwood timber, making a supply of charcoal available and also making it possible to construct plants at low cost and from material of the highest quality. From the forest products in the South large quantities of tanning extracts are being produced at the present time, and there is no reason why this product should not be increased and be a permanent industry, as the reforesting would take place as rapidly as the present supply is used up.

Large bodies of iron ore are available, as well as large quantities of limestone and dolomite, producing, with the fuel and the ore, ideal conditions for the development of the iron industry and for the development of those chemical processes which depend upon magnesia and lime for their raw materials.

It should be possible to manufacture in the South cyanamide for fertilizing purposes, on account of the availability of the lime, coal and cheap power.

It would require a treatise to go into detail and describe the ramification in manufacture of the mineral resources of the South as they bear upon the chemical industry. Therefore, a short list of the industries that could profitably be established in this section will suffice.

Glass manufacture and the manufacture of artificial abrasives from silica products.

Porcelain manufacture from high-grade kaolin, clay and feldspars.

In fact, there are in this section all the materials for the production of all kinds of ceramic wares and terra-cotta, both for building purposes and for other uses.

The manufacture of Portland cement is already fairly well established in the South. Here high-grade cements are produced from the shales and limestone which abound.

Many of the raw materials for the paint manufacturer are found in large quantities, making the manufacture of pigments, paints, wood fillers and abrasives used in the soap trades available for these manufacturers.

Soapstones abound in quantities and of very high grade, making it possible to manufacture from this product electrical equipment, chemical apparatus, plumbing fittings, furnace linings and the various articles of commerce into which soapstone enters.

Barytes abounds in many sections, making it possible to manufacture from this product pigments for the paint trade and the paper-makers.

Asbestos of a low quality abounds which could be used for roofing, insulating materials and products of this kind.

Manganese ores, chrome ores, zinc ores, salt and gypsum make available a supply of products for the chemical industry for the manufacture of permanganate, zinc white, chromate and chlorine products and the many products into which these compounds enter as raw materials.

The economic balance in the South is wrong. The agriculturist depends for his income upon practically two crops—cotton and corn. The ratio of manufacture to agriculture is so small that the agriculturist has no market for products of the soil near at home, and is compelled to raise those crops which find a world market. The conditions for establishing manufacturing enterprises in the South are therefore ideal for the economic development of this great section. The more manufacturers locate in the South, just so much more will the South be benefited agriculturally and be able to diversify its agricultural products. At the same time the labor conditions will be improved; at the present time there is scarcely any occupation for the people in many sections except tilling the soil. Industries, therefore, have available a supply of labor, which, although untrained, can readily be trained for new enterprises and raised to an efficiency equal to that of any other section.

You have referred in your letter to the establishment of the Federal Dyestuff & Chemical Corporation at Kingsport, Tenn., and have asked the reasons for establishing this plant there and a description of the products which the plant will manufacture.

Your first question is answered in the remarks with reference to the availability of raw materials in the South. The climatic conditions are very favorable for an industry of our nature, as it is necessary frequently for many of our operations to be conducted practically in the open. There seems to be a notion in the North that summer in the South is distressing. We have found the winter very mild, making it possible to continue building operations and manufacture without hindrance, while the average temperature at Kingsport in the summer has been no higher than in Philadelphia. The nights are cool, so that whatever inconveniences may be occasioned by a hot day are speedily cured by refreshing sleep.

Our products are founded upon the two great raw materials of the chemical industry—sulphur and salt. We are preparing to manufacture a complete line of dyestuffs, consisting of sulphur and direct dyes for cotton, acid dyes and mordant dyes for wool, dyes suitable for pigments for the paint trade; also pharmaceutical products, and are prepared to manufacture all kinds of high explosives, which are derived from the products of distillation of coal tar. We are at the present time manufacturing large quantities of sulphur colors and taking up the manufacture of wool colors and other colors for cotton in addition to the sulphur colors. We are developing these processes as rapidly as supplies of apparatus and other material can be assembled.

A great deal has been said with reference to there not being supplies of raw material available in this country for the manufacture of dyestuffs, and that the dyestuff industry is a one-nation industry, because the technical knowledge required in the industry is not available.

The question of supply of raw material has been fully answered. We have raw materials available from our coke industries in quantities more than sufficient to produce all the dyes used in the world. The question of establishing this industry, therefore, resolves itself into the supply of technical skill. We have at Kingsport about 35 chemists, graduates of American universities. These men have attacked the problems of dye making, and are developing in the laboratory and in the plant in a practical way dyestuffs equal in every respect to those formerly imported into this country. On account of the energy of the American college graduate and his initiative, work which requires a long time to develop in Europe is being developed at Kingsport in a very short time. It is a great credit to our American colleges and universities that the training of their graduates is such that they are able to attack problems that are as complex and difficult as the manufacture of dyes and solve them as quickly as they are being solved at Kingsport. **With this supply of scientific thought to draw upon, and the public sentiment in this country to back and buttress the efforts of our own scientific men, and a tariff policy which will give as just a protection to the dyestuff industry as is given to other industries, there is no reason why this nation should be dependent upon any foreign nation for its colors, pharmaceutical products or high explosives.**

I trust that you people will be able to sound the slogan, so that we shall be a nation not only independent politically, but independent economically.

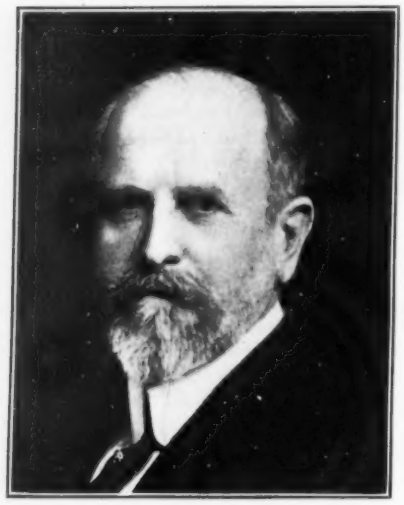
I am pleased to have this opportunity to write this rather disjointed letter to you, but press of business has made it impossible for me to give more than a passing attention to this matter.

John C Hebden

Progress in the Chemical Development of the South.

By David T. Day, Ph.D., Petroleum Expert.

AGAIN and again readers of the Manufacturers Record have had their attention called to the large and exceptionally concentrated deposits of various raw materials for the chemical industry within what are spoken of as the Southern States, and many projects for the development of these resources have subsequently received profitable development. On the whole, however, the development has been very small compared to the very great amounts of chemical materials which could be utilized.



DAVID T. DAY, Ph.D.

It is interesting that these deposits are particularly conspicuous and particularly concentrated, or pure, the farther we go south. Thus, on the borders of Louisiana we find some of the purest rock salt ever found in nature, and close by deposits of native sulphur so peculiarly located that the process of melting the sulphur by steam and pumping out the molten material has proved extremely successful in affording very large stock piles of sulphur sufficiently pure for all practical purposes and unusually free from arsenic and other very harmful impurities.

Closely associated with these deposits are great supplies of heavy fuel oils, which in the early days of the oil industry at least pointed the way to a plentiful and efficient source of fuel, to say nothing of the natural gas which frequently occurs associated with this oil and under heavy pressure. Now, the significance of these oil supplies goes farther beyond its humble use as a fuel. The oil offers in itself a basic material for chemical development involving the production of such compounds as to render the oil much more valuable for chemical work than as a fuel.

These peculiar deposits of raw material are explained to the students in every chemical class in the United States, and it has been the habit to point out the ease with which they can be used in what have come to be the standard chemical processes for the production of heavy chemicals. The steps are simple by which the sulphur is burned to sulphur dioxide, then oxidized by air by the contact process to sulphuric acid, which is not only used commercially for oil refining, fertilizers and a host of other industries, but as a basic raw material for attacking salt, converting it into anhydrous sulphide of soda, which is converted by the well-known Le Blanc soda process into the various commercial varieties of sodium carbonate, and eventually caustic soda.

But we must now go farther and consider how this same sulphur is valuable, even before conversion into sulphuric acid, as an agent in the production of sulphite wood pulp, and for the development of the partially oxidized sulphur compounds which are necessary in the conversion of cotton waste and lintage into artificial silk. This same sulphur opens up a field for the production of carbon bisulphide to the various industries for which the valuable compounds are necessary, for which carbon bisulphide is the starting point.

Again, the salt industry. Now, the native salt of Louisiana and other Southern States is similarly available for the electrolytic processes which produce caustic soda directly without the older and more complicated intermediate steps, and which give as a side product great quantities of liquid chlorine, not only valuable in itself as an efficient disinfectant, but as a powerful agent in the production of other chemical products. To understand these it is necessary to revert for a moment to the chemical possibilities of the crude oil in the Southern States. It has long been recognized that the asphaltic oils of the Gulf Coast are more susceptible to chemical reagents than the paraffin oils farther north. Nevertheless, only the smallest beginnings have been made in the actual production of the great number of hydrocarbon derivatives for which these oils serve as the raw material. To begin with, the simple treatment of these oils, preferably after classification by distillation with chlorine, under proper photochemical conditions, yields a large series of products, from carbon tetrachloride to chloroform, chloral, to finally the chlorine products of asphalts and heavy oils, all of which have the characteristic of non-inflammability. Kept dry, these chlorine substitution or addition products from petroleum are usually neutral, non-corrosive, etc., but by the proper addition of moisture can be oxidized into products of still greater value. It is much more important, however, to consider the petroleum possibilities when starting at a new angle from the crude material.

It is only within the last few months that a great and careful study has been given to the enormous possibilities that exist for converting one kind of hydrocarbon into another, or the members of one series of hydrocarbons in other kinds. The oils of the Gulf States are supposed to contain, and do contain, varying percentages of the class of hydrocarbons known as naphthenes. These are closely related to the aromatic hydrocarbons which serve as a basis for aniline dyes. That is to say, they are aromatic hydrocarbons containing an additional amount of hydrogen. Recent experimentation has shown that it is comparatively easy, by heating these naphthenes above their boiling points, to break them up into other hydrocarbons, chiefly those members of the aromatic series which are most valuable for dyes. In practice it is not necessary to separate the naphthenes from the asphalt and from the paraffin hydrocarbons and the ethylene hydrocarbons which accompany them, but simply to crack the mixed vapors of all of them, and thereby convert more or less of all the different series into aromatic hydrocarbons with a greater and cheaper yield.

Starting with these hydrocarbons and others which are obtained in the cracking processes, such as naphthalene and anthracene, we are able to obtain at will any or all of more than 900 different artificial coloring products, the methods of manufacture of which are well known to the chemical profession; and, in fact, the method of manufacture characteristic of each one is well described in a catalogue of all such dyes issued by a foreign publishing house.

In practically all of these processes three substances are necessary chemical agents in one step or another, and all obtainable from Southern raw materials. They are sulphuric acid, chlorine and soda in one form or another. Lime is frequently necessary also, of which the supplies in the South are ample. With these resources, therefore, every essential element of the aniline industry in all its ramifications are abundantly available, and it is probable that all can be had at considerably cheaper prices than those at which they could be bought in the open market.

Concerning these crude petroleums of the South, recent investigation has also made it evident that oxidation processes are available by which certain important members of these oils may be comparatively easily converted in the future into the fatty acids for soap making and for other purposes. It happens that in this oxidation alcohols are also frequently formed and combined with the fatty acids in the act of formation, with the resultant production of compound ethers. It should become possible by manipulation of this process to modify them in the direction of producing such compound ethers as have value for flavoring, etc.

Again, it has recently proved possible to secure from some of the badly cracked oils after chemical treatment perfumery resembling cedar and consisting apparently of terpenes. Again, by certain variations of the cracking processes it is possible to obtain slightly oxidized products at the same time the oils are broken up from heavy to lighter components; thus formaldehydes from aldehydes and alcohols, and certain new products of as yet unknown composition are obtained. The fixation of atmospheric nitrogen appears to have been accomplished quite economically in this connection.

It may be expected as an accomplished fact that heavy oils of any character can now be broken up into lighter oils of almost any desired character as suitable as the basic material, from which many industries may be branched with commercial advantage. Again, it is evident that if there be added to the cracking process crude sulphur the variety of materials which can be used to furnish gasoline under destructive distillation is greatly increased. This extension, although the commercial features have not yet worked out, looks in the direction of the enormous sawdust heaps from the lumber mills of the South.

The elasticity of chemical methods, so that the chemist can change from one source of material to another and from one process to another for the obtaining of the most efficient result in producing the product which is temporarily most valuable, gives not only aid, but confidence to the investor in these new lines of progress.

Few people recognize the enormous amount of experimenting now in progress by chemists all over the South for the actual development of the products above referred to. Many are now being made commercial in one place or another, but, as usual in new enterprises, the products are sold for export from the South in a condition far nearer the raw material than should be the case. Sulphur is chiefly sold as such. More is sold as sulphuric acid to be used elsewhere as the basis of other chemical products. The same is true of salt, and particularly of the oils which are capable of better development.

While these commercial products may be crude in their nature, the experimenting in many private laboratories by college professors, commercial chemists and others, where many hundreds of new products are available in the form of small samples, show the tangible results of this chemical investigation.

It is greatly to be desired that this article should serve as an appeal to every investigator in chemical lines in the South, and to investigators in other parts of the United States working on similar material, to send all of the peculiar products obtained in these investigations, whether of actual known composition or not, and whether of any prospective value or not, to the Industrial Chemical Exposition to be held this month in New York, where others interested may perhaps furnish the means and the incentive for further work on these special products. Let them send in everything they have made, with as clear a description of the contributing materials and the characteristics of what may be as yet an unknown material, and it is certain that they will be most carefully studied by the many experts who will attend this exposition. The success of this exhibition is assured in advance from the record made by the exhibit last year, and these samples will undoubtedly be of as great interest as any other feature.

Again let it be urged that the raw chemical materials be sent from all

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possible localities to this exhibit, and that care be taken that the size, shape and quality of the material shall tell as much as possible about the quantity and quality of the particular material in question at the place where it is found or manufactured. Dr. G. Brown Goode once made the pungent remark that a good exhibit consisted of a good explanatory label illustrated by a specimen. Let this be the guiding instruction to those who send their contributions to the New York exposition. Tell all you can about what the sample, as where it came from and what it means to chemical industry, if you would have the specimen be of value to you.

The great value of such chemical agents as sulphur, salt and other raw materials for heavy chemicals, and the colossal supplies of these valuables in the South, while known to be well recognized, is very well known compared to the occurrence of hundreds of other mineral resources now adaptable to present needs which were formerly valueless. One naturally thinks of such rare metals as tungsten and molybdenum, the ores of which have been so eagerly sought, and with such considerable success, in the Rocky Mountain States within recent months. Would it not be well for the enterprising commercial mineralogist in the South and for the ambitious prospector to search more diligently for these and similarly valuable materials? The National Government and various State institutions are glad to give such information and such preliminary examination of minerals as will aid the prospector in directing his search to valuable results. They will at least tell you what your minerals are and give you an idea as to whether they are worthy of analysis to determine their purity or the amount present of some valuable component.

An interesting example of the recent use of what was previously waste material is the utilization of thalium from Oklahoma zinc ores. This element takes part in one of the cleverest chemical processes ever discovered. It has been found, in brief, that it is advantageous to add a small amount of a thalium chlorine compound to a tungsten incandescent lamp. When the proper minute amount is added this material partially volatilizes, slightly decomposes, and the chlorine set free combines with the brown deposit which eventually forms on the inside of an incandescent bulb, forming a compound of chlorine and tungsten; and this circulating through the lamp eventually comes in contact with the incandescent wire and is there decomposed by the considerable heat. The tungsten is deposited upon the filament from which it was originally volatilized, and thus through the agency of this compound chlorine affects the return again and again of the tungsten, which has volatilized from the wire and has been deposited on the cooler glass of the bulb.

Another element which has been found lately in connection with other ores is gallium, which will undoubtedly be exhibited at the September chemical exhibit, which is awaiting utilization.

There are few regions in the world where so many varieties of useful minerals have been scattered by nature as in the mountain regions of North Carolina, and it would be gratifying to see every one of these exhibited in all the forms in which they can be found in nature, with a hope, and even a practical surety, of increasing their utilization. Perhaps no better campaign could be undertaken at this time in the development of the chemistry of the South than to bring together at such an exhibit as this every complete process, or process still in the formative stage, for the development of potash salts in the South and the extraction of potash from feldspar and other rocks, and especially, perhaps, the saving of potash from the flue dust of cement mills. The impetus already given to the saving of flue dust containing potash by Dr. Cottrell's method has proved inspiring in this direction, and it should be easily possible, by bringing together all the effort which has been made for the extraction of potash in one exhibit, to bring about potash independence within the next few months.

Similarly a good showing should be made of the efforts, more or less successful, to manufacture nitric acid from the nitrogen of the atmosphere. It is evident that the South has already profited by taking advantage of the psychological moment in several of the many steps necessary for the development of its chemical industries. Many are used, and just now this New York exhibit gives the opportunity for a display of the South's chemical resources' new budding processes, and for newly discovered chemical compounds which will furnish an additional step of progress of no small value.

David W. Day

Chemical Industries and the South: Limitless Raw Materials.

By CHARLES E. COATES, Ph.D., Professor of Chemistry, Louisiana State University, Baton Rouge, La.

IN talking of the South of recent years, I have sometimes found it necessary to explain both where it is and what it is. If by the term South one means that section which lies south of Mason and Dixon's line and east of Texas, this would include a very large part of our country and a great many different kinds of places and people, some distinctly not Southern in the ordinary sense. It is, in fact, difficult to draw the geographical line, but it might be fair to say that the South is that part of the old South where immigration has not materially changed the general nature of the old Southern stock.

CHARLES EDWARD COATES, Ph.D.

It is an even more difficult matter when one comes to say just what the South is. Someone once remarked that Boston was not so much a place as a state of mind. Possibly this might be said of the South with equal truth. When the average American speaks of the South or thinks of it, there comes a vision of the white-pillared plantation home, the broad porch, the planter in white linens, often with white hair, seated in an easy chair and about to take something or other from the solicitous hands of a deferential and smiling negro. There is a subconscious impression of aristocracy, courtesy, hospitality, high-mindedness, sensitive honor and improvidence. There is a dim, passing picture of courtly men and fair maids, of far-reaching fields of cotton and cane, of mortgages and of depleted bank accounts. With it all, there is a feeling that the South stands for something very fine in the development of our country, something which we, as Americans, are proud of in an affectionate way, and when the vision passes it leaves behind a haunting regret that the South is passing, too; that things are not as they were. This is the conventional picture of the old South as we find it in literature and art and as we hear of it in oratory.

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It might seem, at first thought, that it is a far cry from a picture of this sort to a discussion of the chemical potentialities of the South, but I am inclined to think that there is a closer connection than some would imagine. Comparatively few representatives of the moneyed interests in the East and the Middle West have lived long enough in the South really to know it. They know the pleasures of Palm Beach, the shooting and fishing of the Gulf Coast, the gayety of Mardi Gras, the charm of St. Augustine and New Orleans. These they learn by experience, and they go home with the idea that the South is a good place for anything—but business.

In past years, when representatives of a Southern enterprise, thought out by Southern men, have gone to Chicago or New York for capital wherewith to develop it, they have frequently found an atmosphere which was distinctly not sympathetic. They have had to overcome a general impression that the whole enterprise, ipse facto, was fanciful, possibly ill-advised and by virtue of the substitution of enthusiasm for investigation, not sound from the standpoint of twentieth century business. This impression was exceedingly difficult to overcome. The financiers were delighted to meet the gentlemen from the South and would do anything for them except put money into their enterprises. Today the more farsighted of the captains of industry know that their attitude was a mistake and they are sending their capital South, yearly in increasing amounts. They know that the old Southern planters have well-nigh passed away. Their sons, who follow them, have preserved most of the best traits of the fathers, but they have changed their methods. They no longer sit around plantation porches in white linens; they are out in the fields and factories in overalls; they are merchants, bankers, doctors, lawyers. They are working a twice eight-hour day with the same feverish desire for success which is common to most young Americans, but it must be confessed that, as a rule, they are not manufacturers, and in particular, they are not chemical manufacturers.

The reasons for this are numerous. Perhaps one reason might be found in the general nature of Southern education in the past 50 years. At first it was almost entirely classical, a heritage of ante-bellum days. About 20 years ago came the beginning of agricultural education, which is now making such a profound impression on our national life; but it is only within a comparatively recent date that young Southern men have been able to get proper training in the various phases of engineering at home. When they wanted an engineering training they went North to find it, and they found in the North also the opportunities for their life-work which did not exist at home. They rarely returned, and so they were lost to their section. Yet these were the very men the South needed. Had they stayed at home they might have enriched their section not only with the fruits of their own activities, but also by the creation of an atmosphere in which the spirit of manufacturing enterprise might have developed freely. It has been the absence of this atmosphere more than any one thing else which has handicapped the develop-

ment of manufactures in the South, and it is indispensable. Neither manufacturing nor morals can be created by act of parliament, nor can mass-meetings and resolutions from Boards of Trade do much to help the cause.

Within the last decade matters have changed much for the better in this respect. There are now excellent schools of engineering in each of the Southern States, and many of the ablest and strongest students are to be found in them. Even chemical engineering, the youngest member of the family, is already man's size in several places; but the South needs still more engineers, and in particular it needs more chemical engineers. In fact, it is getting increasingly difficult to find large manufacturing enterprises which do not need chemical engineers. The slaughter-house, the blast furnace, the oil mill, the sugar-house and many others are already under strict chemical control, and the increasing importance of utilizing by-products is opening daily new fields to the chemist who is also an engineer.

In the South these facts are well known in an academic way, but in most cases they are practically ignored. Now and then one hears the question, "If such opportunities really exist in the South, why do not the Southern men seize them?" The answer is not hard to find. The South still lacks a sufficient number of industrial leaders, and it has almost no leaders where chemical industries are concerned. This is unfortunate for its financial development, but at the same time it means opportunity for the well-trained man with energy and initiative or for the capitalist who can employ such men.

Without attempting to give the figures involved, it might be of interest to study briefly the conditions attending the introduction of new chemical industries and also the betterment from a chemical standpoint of some of the existing Southern industries. It is well known that many such industries are still carried on according to rule-of-thumb methods and with enormous waste.

Chemical enterprises as a whole may be roughly divided into two classes. In the first class we find those where the finished product requires much labor and sells at a high price, as, for instance, dyestuffs, natural and synthetic drugs and the like. Here the raw materials may come from different parts of the world, but the item of transportation charges is only a small percentage of the selling price. Such industries may properly be located in large centers of population where skilled labor can readily be obtained and to which the buyer comes naturally in the course of normal business routine. At present, one would hardly expect them to spring up in the South, where such centers of population are few; and yet there are several instances in which notable success proved that such development is not impossible.

In the second class we group those in which the weight or the bulk or the general nature of the finished product is such that the item of transportation figures largely, both in the cost of raw materials and in the selling price at the point of consumption. Here we find iron, coal, cement, soda, bleach, acids, cotton oil, sugar, alcohol, resinous and hardwood distillation products and the like. In these instances, the South undoubtedly offers opportunities not surpassed elsewhere. It possesses great quantities of raw materials of excellent quality. It is comparatively near the present markets of the South, the West and the Southwest, and well situated with reference to the future markets of Central and South America. These advantages have already been recognized, and many individual enterprises have been started in the last 10 years. Some are now in successful operation, but some have been flat failures and great disappointments. We are apt to hear more of the last than of the first. A successful man keeps quiet and banks his profits; the failure tells his troubles to anyone who will listen, and this has done the South no good. These failures, however, are frequently easily understood upon a little investigation.

In considering the possibilities of a new enterprise, all men are guided by the preliminary calculations. Where chemical industries are concerned, these calculations often show no reason, at first sight, why such industries should not be exceedingly profitable. Now the calculation of these possible profits is very easy for the amateur and quite difficult for the expert. A company is formed, made up of inexperienced men who know they are ignorant and of practical men who do not know they are ignorant. Here the blind lead the blind. Ordinarily, the practical man has made some superficial estimates and has convinced some men with money that they can make more money. So the company sells its stock, gets its money in bank, buys its site and its machinery and contracts for its material. Anyone can do this. Anyone can spend cash money, and the practical man does it admirably. The company pays, as a rule, little attention to the selling end, knows nothing of market conditions, plunges ahead with energy and is brought up with a sharp shock at the end of a year or so by the stern facts of bankruptcy, all the more unpleasant because unexpected. The men are honest, hard-working, well-meaning, and so the failure to get the calculated profits must have been due in some mysterious way to the section they live in—to the South.

As a matter of fact, a real calculation of these profits is by no means easy—a great many different factors go to make up profits—but there are men today, chemical engineers, who can make such calculations with exactness. They can steer one away from discarded or freak processes. They can show the pitfall of building too large or too small a unit. Sometimes they can even point out the danger, known only to the initiated, of running up against a selling corporation which has a practical monopoly because of the gentlemen's agreement between the big firms back of it.

Unfortunately, the value of expert advice of this type has not been thoroughly realized in the South. I know, personally, of a number of instances in which thousands of dollars might have been saved had the promoters been willing to spend a few hundred dollars for a careful report from a reputable firm of consulting chemists. In this respect, it is true, there has been lately a remarkable change, but the condition still exists generally. No better instance could be given than the string of abandoned plants for distilling lightwood which dot the South from Carolina to Texas. With startling regularity these flared up and went out, leaving behind only ruin and discouragement. For all that, certain individual pine-products plants are today making large profits, but in each case the chemist sits at the right hand of the president. The layman may write it down as an axiom, "never invest any considerable sum in any chemical industry until a report on the project has been made by experts." This is applicable everywhere, not only in the South.

One of the first inducements offered to a prospective chemical plant is cheap power, and here the South can both promise and make good. One obvious source is the streams on the east and west slopes of the Alleghanies. Many hydro-electric plants have already been set up on the east slope, but many more sites remain unoccupied. Congress is now considering developing to its fullest extent the water-power at Muscle Shoals for the electro-synthesis of nitric acid from atmospheric nitrogen, an admirable project which has been generally commended both for patriotic and for engineering reasons. Willson made his first carbide at Spray, N. C., and from this point the carbide industry spread all over the world with millions invested everywhere, except in the South, which is rather queer when one remembers that in the South limestone, coke and electric power can be obtained as cheaply as anywhere on earth. According to recent reports, hydro-electric plants are shortly to be erected in Carolina for the manufacture both of nitric acid and of calcium cyanamid. There is room and opportunity in the South for several such plants, and they should prove exceedingly profitable.

Water-power, however, as a source of energy has certain disadvantages. Unless only a fraction of the possible power be utilized, there comes a term of dry weather when there is not enough power available to do the work required of it. This has proved embarrassing on occasions, and has been met, in some cases, by the establishment of an auxiliary battery of dynamos, driven by gas engines. In such cases, a careful study of the relative cost of electric power from the two sources has shown the somewhat surprising result that electricity can be produced about as cheaply by internal combustion engines as by water-driven turbines. If these statistics are correct, it would seem that an electric plant situated near the mouth of a coal mine could generate and distribute enough electricity to meet the demands of a whole manufacturing district, just as the Niagara plant does, with the probable springing into existence of a similar series of chemical plants of the most varied types. The low cost of electricity generated in this way has led to the recent experiments on electric smelting in Northern Alabama, which are already successful commercially. It is more than possible that the next 10 years may see a complete change in the methods of producing pig-iron. The many advantages of electrically-smelted iron are well known. With cheap electricity from cheap coal, found near high-grade limestone and iron ore, the South may yet be the center and the master of the iron industry of the world.

But water and coal are not the only sources of power in the South. There are also the oil fields of Louisiana, Texas and Oklahoma, and, for that matter, the Mexican oil fields, which can, if necessary, supply the Gulf coast by tank steamer without transshipment.

The great Caddo gas field in North Louisiana is one of the most neglected sources of power in America today. This gas is about 95 per cent. pure methane, and the calorific value is over 1000 B. T. U. The geological indications are that the gas supply will be practically permanent or of long duration, and yet with the exception of a glass works in Shreveport and a few minor enterprises, it has called no new industry of magnitude into existence and is even today almost entirely used for local purposes—heating, cooking and small power plants.

In Winn parish, not far off, is an unlimited supply of high-grade limestone, and the whole country is full of good clays. With cheap gas, limestone and clay all thrown together by the hand of Providence, why cannot the hand of man build a successful cement factory at the same place? It is said that the cement industry is thoroughly organized and newcomers and new plants are "discouraged" from entering the field. If this be true—"but that is another story."

There are in North Louisiana large deposits of lignite. I have analyzed a dozen or more samples from various parts of this deposit, and I have found them uniformly of good quality. They can be mined cheaply by uncovering, and they are absolutely unused for any purpose, though they could be made to yield briquettes, or could be distilled destructively.

As mentioned before, there are several excellent deposits of limstone in North Louisiana, not much good as building stone, but admirably adapted to making lime. There are also salt wells in the near vicinity from which salt was made for many years. With lime, salt and cheap electricity from gas oil, why should not this section produce chlorine, sodium and bleach? It is, at any rate, well worth looking into.

Even more remarkable are the absolutely uncorrelated chemical possibilities of South Louisiana. If one leaves New Orleans rather early in the morning it is possible to visit in one day the salt mines at Week's and Avery's islands, the oil fields at Jennings and Vinton, and the sulphur mines just outside of Lake Charles. To a chemist, the most interesting thing about these really remarkable deposits is their extraordinary purity. The salt from Week's Island shows on analysis 99.6-99.8 pure sodium chloride. The sulphur is almost chemically pure, averaging 99.6-99.9 per cent. sulphur. The oil, on the other hand, is a fuel oil.

Now here we have chemically pure salt from which to make acid, bleach, sodium, hydroxide, sodium carbonate, sodium sulphide, and the like. These could all be made in unlimited quantities, chemically pure. This would require a great deal of sulphuric acid, of course, and cheap power as well. A few hours away lies the most remarkable deposit of sulphur in existence, chemically pure and admirably adapted to the making of sulphuric acid by the contact process, already mined and ready for shipping—out of Louisiana. Cheap power and raw materials of almost unthinkable quality and quantity—yet nothing is done. They look like the parts of some great engine which

have not been put together because the master mechanic has not yet come. In this same section are forests of pine, cypress, cottonwood and gum. These are now made into lumber, and everything except the lumber is burned. Now, each of these woods makes good paper stock, and the price of paper is going up daily. There seems to be no reason why it should not stay up, as there is a well-recognized lack of the raw material from which it is usually made. The whole question has been thrashed out in the newspapers, which are so vitally interested; addresses have been made, articles have been printed, and yet the fact remains that there is not a single mill either in Louisiana or Mississippi which makes printing paper. Indeed, there are only two of any sort—one at Bogalusa, La., and one at Moss Point, Miss., where a good grade of kraft paper is now being turned out.

Several unsuccessful attempts have been made to get someone to make soda and bleach to supply someone else who is to make the printing paper from part of the Southern waste. The arguments which have prevailed are something like this: "How can we afford to make soda and bleach when there is no local demand for it?" and "How can we afford to make high-grade paper when there is no local production of bleach and soda?" These two questions have been chasing each other in a circle for some years.

Wood waste is not the only thing paper can be made from in the South. It has been shown experimentally that many of the native grasses, rice straw, sugar-cane bagasse, cotton stalks and the like make excellent paper. Sporadic attempts have been made to utilize these, but without success. In a few cases I have had occasion to look into the reason for the failure, and in each case the answer was the same—a highly technical scientific industry was being undertaken without competent scientific management.

In addition to pine and cypress, there is much hardwood in the South—oak, ash, hickory and beech. This also is being cut for lumber with the usual waste, yet I do not know of a single plant for the destructive distillation of hardwood in Louisiana, Mississippi or Alabama, though a plant at Memphis has done exceedingly well in spite of the fact that it has a long haul for its wood. Surely there is an opening for a chemical industry in this line further South, and also for additional plants for the destructive distillation of pine, where the technical difficulties have been practically overcome of late years. Other wood by-products which are not made in the South to any extent are pasteboard, fiberboard, papier mache and surfaced building boards. There is a local demand for all of these things, and they can be made here as cheaply as anywhere.

Another product peculiarly Southern is cotton, both the fiber and the seed. Cotton mills are probably not to be regarded as chemical enterprises, though calico printing and dyeing are, but the cottonseed must pass through a number of chemical operations before it can be used at all. When the seed gets to the oil mill it is first delinted. These "linters" are used in large quantities as a source of pure cellulose, for guncotton, smokeless powder, celluloid, celluose acetate, artificial silk and many other cellulose products, not one of which is made today in the South, which produces the cellulose. The delinted seed is then hulled and pressed. The meal is used as cattle food; it is almost too expensive for use any longer as a fertilizer, and it is continually growing in esteem. Of late it has been tried as a food for man, but it has not gained any serious footing here, even though the experiments were successful. The fact seems to be that there are many different grades of meal, some of which are not palatable. If the seed itself could be graded before milling, from the standpoint of flavor, this difficulty might be overcome, a new source of human food found and new chances for food chemists as well.

Because cottonseed is bulky, the milling has always been done in the South. The crude oil, however, is run into tank cars and shipped, usually to a city like Savannah or New Orleans. Here it is refined and reshipped. A small quantity is made into cooking oil at the Southern plants, but the greater part is sent North, where it is turned chemically into artificial lard, butterine and soap, much of which is shipped South again. These things could be made just as well in the South, with an initial advantage of a double freight charge in favor of the South, but they mostly make the round trip North and back, as any grocer can testify.

Then there is the recovery of glycerine from foots and soap stock in general. There are a few glycerine plants in the South. One has recently closed down because it could not get the raw material. Here is the keynote to the whole situation. The South is shipping out its raw material, and none of it is left. It is the custom, it is the easiest way, and nine-tenths of the ultimate profits go elsewhere.

Then there is the matter of industrial alcohol. There are several large distilleries in New Orleans and other cities which ferment molasses only. With the present high price of molasses these plants are considerably handicapped, and yet there are many starchy grains, tubers and roots, which can be grown cheaply in the South and which would do well as a source of alcohol. They are not so grown because there is no demand for them, and there is no demand because they are not grown.

With the present high price of gasoline, industrial alcohol ought to be a strong competitor, and, indeed, it is already largely used for motors in Cuba. In this country there is still a good margin in favor of gasoline, but with alcohol at from 25 to 30 cents a gallon, there would be practically an unlimited demand for it, provided a little of the Government red tape which binds it now could be untied. This is far below present prices, and could not be reached except by exerting the utmost care in its manufacture, and this includes the utilizing of all possible by-products. But in many of the plants with which I am acquainted, there has been little or no chemical or scientific control, and none of the by-products have been recovered until within the past few months, since which time an attempt has been made to work the vinasse for potash. There has always been enough money in the industry as it stood, and I doubt if a serious attempt has yet been made to place industrial alcohol on the market at the lowest possible price. A few years ago great things were expected of cheap alcohol. These expectations have not been realized because alcohol has never been cheap enough, but all the old promises may yet be fulfilled when the South realizes its possibilities in this line.

Another phase of the introduction of chemical industry in the South, and one of the most important, is the matter of finances. It may as well be admitted frankly that we have not an overplus of free capital. The South is growing richer year by year at a remarkable rate, but there has always been opportunity to invest every dollar saved in existing enterprises and at good rates. There has always been so much to do. A country devastated by war and confused by a chaos of labor conditions, had to be rebuilt from the ground, and the building is still going on. Men coming South with new chemical enterprises of merit can count on getting, locally, a fair fraction of the money necessary, but not all of it. Most chemical enterprises require considerable initial outlay, and even under the best supervision a period of costly mistakes must be passed through before commercial efficiency is reached. All of this requires capital. Here is one more reason why the South has not fully developed its chemical possibilities, and here also lies the opportunity for outside money.

I have endeavored to outline, as I see them, the chemical potentialities of the South and in particular to keep away from over-enthusiasm. This is hard to do for one who knows the South as a land of opportunity and has seen the sources of wealth which lie on every side, awaiting scientific development. Great things are in the air, and the chemist, too, is called on for great things. The South asks him to make bricks and iron and food and clothing for the whole country and to make them better and cheaper than they have ever been made before.

I have given here but a few examples affecting chemical industries in the South. They might be multiplied indefinitely, but that is not necessary to illustrate the point. There are, of course, many individual enterprises which are run in a manner beyond any criticism, but they are the exception. In general, the South is still exploited for its raw material, with which it is so lavishly endowed. This is not necessary. Labor conditions today are good throughout the whole South. It is a good land to live in—a very good land for a real American. He will find himself at home here as perhaps nowhere else in the country. The people are ambitious, intelligent, enterprising, quick to recognize merit, but they cannot take the initiative in chemical enterprises because they do not know where to begin. They lack leaders in chemical industries. Most of all, they lack men who can organize the individual producers of raw material into a co-operative whole, men who can show the salt man, the sulphur man, the oil man, the paper man, the lumber man, that their interests are interdependent; that if they work together each can double his profits and build up his section as well. Anyone who can get the confidence of these producers and can make them join hands for their common good has enoromus opportunity in the South, for the prime need of all its chemical possibilities is organization and co-operation.

Charles H. Brookes

"Team Work" Essential, for Possibilities Are Almost Limitless.

ANDREW BRYSON, Mem. Am. Soc. Civ. Engrs., New Castle, Del.

TO comply with your request for an expression of my views on the subject of "The Chemical Potentialities of the South" in any except the briefest degree is impossible. The field is too great; the possibilities almost limitless, and the public benefits which must accrue to successful chemical research work in the many lines cannot be measured.

The science which has accomplished such wonders in the past few years, making common and of every-day use that which a few years ago, if thought of at all, would have been placed among the "impossibilities," is still hardly beyond the threshold, and I doubt if any mind today can conceive what will be done during the next fifty years.

To obtain the best results in the shortest time, however, there must be good "team-work," and that is something we in this country have sadly lacked.

Suppose there should be established a Bureau of Science and Research, an adjunct to one of the existing departments of the National Government, in which all of the scientific work now divided among the various departments would be concentrated; all State and private laboratories to be in touch with it, and receive instructions or suggestions from it; daily or weekly pamphlets issued by this bureau would indicate to all what each was doing, and what progress was being made in every branch; the magnitude of the work would warrant payment of very high salaries to the leading men in the several lines, duplication of work and wasted effort would be largely, if not entirely, eliminated, and the results to the country would be incalculable.

Our people have always lacked in appreciation of "team-work." Individualism has run riot, and there is no need of wasted work done by individuals simply for lack of knowledge of what others are doing. Government departments are duplicating the scientific work of other departments at an enormous waste of the taxpayers' money, and it would seem that our future scientific work must be done under some such conditions as are here outlined if the most is to be made of our opportunities.

Your efforts seem to me most commendable and you have my best wishes for success.

Chemical Industries in the South: "Tremendous Development in the Near Future."

By Edward Hart, Ph.D., Easton, Pa.

THE last quarter of a century has seen a wonderful change in the chemical activities of the United States. In 1893, when I became editor of the Journal of the American Chemical Society, the membership was under five hundred; by 1901 it had risen to two thousand, and at the present time has reached eight thousand members. While this increase in membership does not represent absolutely the increase in chemical activity, it does measure it approximately. Until recently the largest part of this increase in activity has been confined to the Northern States. Notable exceptions are the Mathieson Alkali Works at Saltville, Va., which, during this interval, has been developed from an old-fashioned salt works into a great modern producer of soapmaking materials, and the Tennessee Copper Co. at Copper Hill, which has become one of the greatest producers of sulphuric acid in the United States, and one which, because of the low cost of production, is destined, with the development of railroad facilities, to increase to vastly greater proportions.

EDWARD HART, Ph.D.

Before the cutting off of chemical supplies from Germany had started the present wonderful development, a considerable feldspar industry had developed along the line of the Clinchfield Railroad, and this has increased until a very considerable portion of the feldspar used in the pottery industry now comes from this source. At about the beginning of the period in question the Williams Mill, near Bristol, Va., was turning out ground barytes, blank fixe, barium chloride and satin white, but failed after operating for some years. Over two hundred miles to the southwest, at Sweetwater, Tenn., a small plant had likewise been in operation, producing barium carbonate and sodium sulphide. With the advent of the war came higher prices and stronger demand. The Sweetwater plant then came into the possession of the Durex Chemical Co., with the Brothers Toch as the leading spirits. These gentlemen have secured control of large tracts containing barytes, and have so perfected and extended their plant as to bid fair to become considerable factors in the future chemical development of the South. Barytes deposits are found also near Cartersville, Ga., and this source of supply has been made use of very largely in the last few years, many thousands of tons of the ore having been shipped to the North and West. Barium compounds have grown in importance with the development of the lithopone industry. Lithopone is a compound of barium sulphate and zinc sulphide, a pigment of great and growing importance. Barium is also used in the manufacture of hydrogen peroxide, which is coming into use as a bleaching agent and disinfectant.

Blanc fixe or precipitated barium sulphate is used as a basis for lakes and for finishing paper, in printing ink and as a very high grade filler in the rubber industry and photography.

In the manufacture of barium compounds from barytes sodium sulphide is produced in large amount as a by-product, and this has been used in recent years for several purposes, prominent among these for dehairing hides and for dyeing with sulphur black. This black and other dyes are produced by the Federal Chemical Co. at Kingsport, which will also produce considerable amounts of picric acid, trinitrotoluol, phenol, etc. This new industry, the cement plant and the tannic acid plant at Kingsport, as well as the feldspar mill of the Clinchfield Products Corporation at Erwin, are greatly indebted to the Carolina, Clinchfield & Ohio Railway, which has shown great enterprise, first, in giving us an across-country railroad of the best up-to-date type, and second, in developing the industries located on its right of way. Among these not the least important are the coal fields operated by the Clinchfield Coal Co.

The salt deposits at Saltville were at one time worked for salt. The supply of brine here is practically inexhaustible, and, as salt in large amounts is required by the new industries, it seems altogether likely that one or more salt works will be established in the near future.

Another product likely to be turned out is calcium chloride, which is a by-product of the Mathieson Alkali Works. It is used as a top-dressing for roads to keep down dust, and in the chemical industry.

The South is the center of a flourishing lumber industry of three varieties. There is the lumber from the long-leaf pine, the cypress and the hardwood. The offal from the yellow pine, branches and stumps, is being used more largely every year as a source of turpentine of various degrees of purity. So far the offal from the hardwood has been allowed to rot for the most part. This may—and in the future, no doubt, will—be used in manufacturing charcoal, acetic acid and methyl alcohol.

Because the South is the center of barium production, the low cost of coal and the excellent railroad and shipping facilities have recently led to the establishment of the chemical works of the Clinchfield Products Corporation, which expects to manufacture a large line of chemicals at Johnson City, and of the Federal Chemical Co. at Kingsport. In so far as the chemical industry is concerned, the future seems to be full of promise for the South. The immense chemical works established throughout the Southern States for the manufacture of fertilizers, the occurrence of phosphate in South Carolina, Florida and Tennessee, which makes this possible; the wonderful mineral resources of North Carolina and Tennessee, all point toward tremendous development in the near future. The immense agricultural possibilities of the South have, so far, only been skimmed.

With the development of better educational facilities and habits of thrift will come a tremendous market to take care of a production a hundred times that supplied by present facilities.

In this development the railroads of the South are taking a prominent part. The Norfolk & Western Railroad is well known as second to none in the country for good management. Public approbation has recently been shown by great advances in the market price of its stock. The Southern Railroad, the Louisville & Nashville and the other great lines of the South help and are helped by the industries on their lines and are showing a new appreciation of their privileges and responsibilities which gives promise of great things for all concerned, since co-operation spells dividends.

Edward Hart

EDWARD HART, doctor of philosophy and ex-fellow of Johns Hopkins University. Editor *Journal of Analytical and Applied Chemistry*, 1887-1893, and *Journal of the American Chemical Society*, 1893-1901. Connected with Lafayette College Chemical Department since 1874, and head of department, 1881-1916, when retired, retaining only professorship of chemical engineering. Dean of the Pardee Scientific Department of Lafayette College since 1909, and librarian of Henry W. Oliver Chemical and Metallurgical Library since 1900. Member Institute of Chemical Engineers and numerous other scientific societies; proprietor of the Chemical Publishing Company, and vice-president of Clinchfield Products Corporation.

"Wonderful Possibilities in Clay Resources."

Charles L. Parsons, Chief, Division of Mineral Technology, Department of the Interior, Bureau of Mines, Washington.

I AM very glad that the Manufacturers Record is taking up this work and bringing out prominently the great mineral resources of the South and the help which the chemists of the country can give toward the development of these resources. I am sure you will have many letters commendatory of this effort on your part. Personally, I feel that I may perhaps render the best service by confining myself to a short statement of the wonderful possibilities that lie in the development of the clay resources of the South for the development of the ceramic industries, especially the pottery industries.

As you know there are immense deposits of kaolin, both primary kaolin in the mountains of Virginia, North and South Carolina and secondary kaolin in South Carolina and Georgia. These latter lie chiefly in what is known as the Coastal Plain. These secondary kaolins are present in other Southern States, notably Florida and Alabama, and they offer a basis for an extensive industry in electric porcelain, white tile and chinaware. These kaolins have up to the present time been largely used in the paper trade, where they have brought a comparatively low price. It is probable that they will continue so to be used, but it will perhaps interest your readers to know that recently co-operative investigations were carried on by the Bureau of Mines and one of the kaolin industries near Macon, Ga., to develop methods by which at least kaolins of that region can be utilized for the very highest class of tiling and hotel chinaware. A bulletin bringing out the details of the methods of treatment will soon be issued by the Bureau, and methods can then be tried out by other kaolin companies.

The reason these kaolins have not heretofore been available has been due to the excessive shrinkage and impurities, rich in color-giving constituents, such as titanium oxide, which could not be eliminated. It has been found that if these kaolins under technical control are treated with just the right amount of sodium hydroxide the clay slip is rendered much less viscous, the clay itself stays in suspension, and the fine particles of titanium minerals, such as rutile, ilmenite, etc., are quickly and readily settled out. This can be done at a very low cost. The clay slip so purified is then neutralized with sulphuric acid, settled, and filtered in the usual manner. With the purified kaolin prepared in this manner some of the finest white tile and white hotel ware has been made. This ware is even lighter in color and stronger than ware made from the best imported English china clay, and Cornwall stone is made entirely from American materials.

This purified clay is already in the American market and is being used by some of the Ohio potters at a price which has redounded both to the benefit of the clay producer and to the pottery manufacturer. It is hoped that with first-class materials of this kind at its doors the pottery industry itself may attain a foothold in our Southern States.

The Rosin and Turpentine Industry, and the Chemist.

By JOHN E. TEEPLE, Ph.D., New York, N. Y.

THE United States produces more turpentine and rosin than all the rest of the world. Our total annual production is usually worth over $40,000,000. Our exports in one year exceeded $27,000,000, and are usually in normal years over $20,000,000. The industry is not a new one. Over 100 years ago we were exporting considerable quantities of rosin and turpentine. Forty years ago our exports of these products were nearly half in quantity what they have been in recent years, but only about one-fifth in value.

JOHN E. TEEPLE, Ph.D.

Notwithstanding the magnitude and age of the naval stores industry, however, it developed largely without the aid of the chemist. Only within the last 10 or 15 years can he claim to have played more than a minor part, but recently his contributions have been of extreme importance. We may discuss the chemical contributions under four heads:

1. Improving the quality and quantity of rosin and turpentine produced from the living tree.
2. Providing standards and detecting and preventing adulteration.
3. Finding new uses and enlarging the markets, particularly for rosin.
4. Utilizing the rich dead pine (lightwood) and various pine wastes for the manufacture of naval stores.

The methods of producing rosin and turpentine from the living tree made very little progress during the whole nineteenth century. Timber was plenty, land, leases and labor were cheap, and there was a profit to be had by existing methods. The method consisted in hollowing out a cavity near the base of a pine tree and cutting away bark and wood to leave a smooth face for a few inches above it. Then every week from spring till fall a V-shaped chip about an inch wide was cut through bark and wood above this face, each chip being just above the preceding one. Thus inch by inch the scarred face crept up the tree, to the extent of say 30 inches a year, and at each chipping the oleoresin from the wound flowed down the scarred face till it reached the cavity at the bottom, whence it was dipped out for distillation with water over direct fire to produce volatile turpentine and non-volatile rosin. Every year the thick, gummy exudate had to flow over a longer stretch of discolored scarred face and be exposed to longer evaporation of turpentine before it reached the collecting cavity at the bottom. And so every year the producer's rosins were darker colored and his yield of turpentine smaller.

But conditions began to change. Many lumbermen refused to have their trees bled for turpentine, as it decreased the value of the lower end of the tree for lumber and very largely increased their loss of timber from forest fires and from windstorms. Timber was not so plentiful as had been supposed. Prices of lands, leases, labor and materials were all rising. The cost of producing turpentine and rosin today is probably three times what it was 25 years ago. So the producer called for help. He looked first to France. There they were able to bleed a tree for many years—one is said to have survived 200 years—while here four years was about the limit of profitable operation. There they planted large orchards of pine trees for the express purpose of turpentining them. There they made much narrower gashes in the trees, used a cup and gutters to collect the oleoresins, instead of allowing them to flow long distances over the scarred face into a hole in the tree, and there they accordingly made lighter colored, higher priced rosins, and bleached them still further in shallow pans in the sun, changing, for example, a K rosin into the much more valuable water-white rosin.

A study of the French methods seemed, however, to show that they were not, as such, applicable to existing conditions here. But there was an idea there, and to C. H. Herty, a chemist, and now president of the American Chemical Society, is due the credit first of working out that idea in a scientific and practical way to fit conditions here, and second, what was probably much more difficult, of persuading the operators to use his methods for their own good. Herty conducted careful comparative scientific experiments and showed clearly:

1. That there was no physiological reason for the marked coloration of rosins during the later years of operation as compared with the first or virgin year, but that this coloration was due to oxidation of the resin acids during the longer flow from the point of exudation to the receptable, "the box," and especially to the absorption by the fresh oleoresin of the old oxidized resin on the face of the tree scarified during the previous years. By using an outside receptacle attached to the tree and moving it annually up the tree near the point of scarification only the best grades of rosin were obtained.

2. The flow of the oleoresin over long surfaces resulted in heavy loss of the volatile spirits of turpentine.

3. The cutting of "the box" resulted in destruction of much of the timber by fire, wind and insects.

4. Most important of all, it was demonstrated that the unboxed pine tree would produce 25 per cent. more crude turpentine than the boxed tree, due to greater vitality of the tree.

Early commercial confirmation of the experimental results led to the rapid substitution of the long used "box system" by the practical, cheap and efficient "cup system." The use of the cup system was not thoroughly efficient for several years, as was evidenced by the low yields of early spring as compared with the later yields. The explanation of this shortcoming was apparent when Tschirch, of the University of Berne, published his views on resin flow, and then by a slight modification of woods practice the difficulty was overcome. The total waste which the chemist has made possible to be saved in the South in this industry (a considerable part of it is already being saved) must amount to over $10,000,000 per year.

But the end is not yet in sight, for, according to Herty, laboratory experiments on perfectly fresh specimens of crude turpentine show that its normal content of spirits of turpentine is approximately 30 per cent., while under most favorable methods of collection and distillation at present yields of only 18 to 20 per cent. are obtained. This loss of at least one-third of the volatile oil by evaporation remains still to be overcome.

As to other improvements in manufacture, not much progress has been made. The French method of bleaching rosin seems too slow and laborious, and many chemical methods have been suggested instead, but up to the present have not made much headway. Methods of distillation without the use of direct heat, such as using superheated steam or distillation in vacuum have been suggested, but have had little influence as yet on methods of manufacture. The United States Bureau of Forestry has recently been studying the question of chipping, and has published results indicating that a one-half inch chip gives about as good a flow of oleoresins as an inch chip, besides being less injurious to the tree. They further recommend chipping every four days instead of once a week, thereby increasing the yield in a season. It has been objected that the tree may not be able to stand this excessive bleeding. The method is still to be tried in practice.

When turpentine was comparatively high in price, many substitutes, chiefly from petroleum distillates, and many methods of adulteration were found. Presumably we must give the chemist credit for these, too. The question of adulteration particularly became a serious problem, and provoked a flood of literature devising tests for various impurities and additions. Most of the large consumers finally evolved specifications to fit their requirements, and many States have passed laws for preventing and punishing adulteration, so that conditions now are much improved, for which we may also thank the chemist. There is still much work to be done, however, in standardizing turpentine specifications to fit the consumers' specific requirements. As they now stand, with rather arbitrary figures on specific gravity and distillation, we no doubt often include material he really does not want and exclude material he could perfectly well use.

Rosin has usually been too cheap to suffer from adulteration, except with dirt or brickbats. The chemist has little to do with its purity or grading. Recently, however, the United States Bureau of Chemistry has proposed a series of permanent standards for the different grades of rosin, based on definite transmissions of red and yellow light for each grade.

In extending the markets for naval stores the chemist has done little for turpentine. It has had three uses for many years:

1. As a solvent for gums in the manufacture of varnishes.
2. As a vehicle in the manufacture of paints.
3. As a thinner in the application of paints.

The chemist has more often striven to avoid its use in these fields than he has to extend it. Two new fields have been opened within recent years by chemists—one the manufacture of synthetic camphor. This has been carried on to a considerable extent in a commercial way, and will be again whenever satisfactory relations exist between the market prices of turpentine and camphor. If the yields of camphor could be made more satisfactory, it would no doubt become a permanent industry. But at present, with the price of the raw material, turpentine, and of the finished product, camphor, independent variables, and no large margin in any case existing above the fixed manufacturing cost, the outlook is not enticing to the investor.

The second new field opened by the chemist is the manufacture of synthetic rubber. Synthetic rubber can be made from isoprene, and isoprene can be made from turpentine, but whether this is the best way to make synthetic rubber, and whether turpentine is the best source of isoprene, and whether synthetic rubber can compete with natural rubber in the long run, anyway, are still open to discussion.

With rosin the chemist has had more opportunity. He puts it into shrapnel shells, and sometimes into varnish. In the presence of an alkali, rosin acts as an acid, forming resinates. Combined with an amount of soda insufficient

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to saponify the whole, it forms rosin size, extensively used in the manufacture of papers, where the rosin deposited in the paper prevents the spreading of ink and moisture. This accounts for a very considerable amount of the medium grades. A somewhat higher grade of rosin, when saponified, forms a valuable constituent of, or addition to, many soaps. Combined with zinc, manganese or the alkaline earths, rosin gives resinates used extensively in varnishes.

A very large amount of rosin, particularly of the lower grades, is distilled for the production of rosin oil. The lower grades of rosin oil, when mixed with lime, set to form a semi-solid mass (axle grease) extensively used as a lubricant. Better grades are used extensively in the manufacture of printing ink, so that the marvelous increase in printing and paper during the last fifty years has furnished an outlet for rosin in two directions. All of these, varnish, soap, paper and printing industries, have furnished abundant fields where the chemist has exercised and continues to exercise his ingenuity on rosin and its products.

In the manufacture of rosin oil the yields and quality are not always what they should be. Recent suggestions of different methods of distilling promise much larger yields of better quality oil with smaller amounts of by-products.

In the utilization of lightwood and various pine wastes more chemists have been active than in any other field of the turpentine and rosin industry. Of the many processes that have been suggested and worked out in this field, only one, the method of extraction with a solvent, produces both turpentine and rosin in a commercial way, and only one solvent, a petroleum distillate heavier than gasoline, has so far been commercially successful.

This industry of wood turpentine and wood rosin, as they are called, has had a hard fight to make its way, but it is gradually making it, because there is a very definite need for utilizing the waste that constitutes its raw material. During the years of high prices for turpentine and rosin, in 1911-1913, probably more than 10 per cent. of the total rosin and turpentine production of the country consisted of wood rosin and wood turpentine. The production fell off markedly during the succeeding period of low prices, but it is rising again on a firmer basis than before.

Besides working out processes and designing plants, the chemist in the wood turpentine industry had at least three important problems to solve. He must standardize his goods, he must find markets where they could be used without prejudice, and he must find uses for his new by-product, pine oil. All these problems he has solved—the last one, indeed, has been solved so well that the once despised pine oil is now worth much more than turpentine.

Now as to the future of the extraction of turpentine and rosin from wastes: Let us look first at the composition of the material with which we have to deal. Assuming that this is what we know as fat lightwood or as fat lightwood stumps, it contains rosin, turpentine, pine oil and the wood fiber. The problem is: In what way can all these products be extracted and placed on the market to bring the largest net amount to the manufacturer?

In some places where the timber has been very largely the long-leaf pine, there is the additional factor of so locating his plant that he can entirely clear the land and largely enhance its value at the same time that he is furnishing his plant with raw material. In the future this will no doubt have an important bearing on the establishment of plants, but it will not be considered here. Suppose we have 5000 lbs. of very rich, fat lightwood stumps. Suppose this contains 20 per cent., or 1000 pounds, of rosin; 40 gallons, or 300 pounds, of turpentine and pine oil, and 15 per cent., or 750 pounds, of water. This leaves nearly 3000 pounds of wood fiber. If we extract this lightwood with a volatile solvent properly selected and properly applied, we can recover nearly the whole of the rosin, turpentine and pine oil, and have left the wood fiber unchanged. The rosin, the turpentine and the pine oil will be in such condition that they can be made into the best grades it is possible to produce from wood. The wood fiber is free of rosin, and is in just the condition required for digestion to manufacture wood pulp. According to information and experiments, it gives a good yield of a very strong-fibered pulp. Probably it will work up best into what is known as Kraft pulp, or undercooked pulp, and this 3000 lbs. of wood fiber remaining should furnish about 1500 lbs. of good marketable pulp.

Our wood fiber has two disadvantages as a source of pulp. In the first place, it cannot be entirely freed from the charcoal and charred and burned wood, and in the second place it will not be entirely free from bark, but there is no question that it will produce a good grade of brown wrapping paper, and with this addition we have made a very complete utilization of our 5000 pounds of wood. The difficulty heretofore has been that the naval stores manufacturer has approached the problem with the view of making the wood pulp plant an annex to his existing plant. The wood pulp plant is the more expensive, requires the more skilled labor, and is by far the more important, so that the rosin and turpentine production should be considered rather as an annex to the pulp plant, or, better still, the whole should be considered as one complete proposition. Many people have this combination of rosin, turpentine, pine oil and wood pulp in their minds at the present time. There is no doubt that it will be tried before long. It is only to be hoped that when it does receive its trial it will be under the supervision of men thoroughly acquainted with both the wood pulp industry and the wood extraction industry, and with the aid of the most competent chemical engineers there are available. In this way it can build on the mistakes of its predecessors, and it seems to me to stand an excellent prospect of success. Too much good work has gone into this industry, and too much accumulated information is available to allow it to languish. I feel sure it has an important future, and when its success ultimately comes, very large credit will be due to the chemists and chemical engineers who have made it possible.

J. E. Teeple

The Development of Chemical Industries in the South and Southwest.

By Wm. B. Phillips, Austin, Tex.

THE seven main factors which are to determine the extension of chemical industries in the South and Southwest, as in any other parts of the country, are:

1. Accessible raw materials.
2. Cheap fuel or other source of power.
3. Capital.
4. Business management.
5. Technical skill.
6. Suitable and reliable labor.
7. Available markets.

Detailed discussion of the first item, viz., accessible raw materials, may be omitted, in view of the fact that no other portion of the country can show a greater variety or a larger supply of practically all of the materials that enter into this matter than the South and Southwest.

It is not now, nor has it ever been, a question of raw materials. No one who is at all acquainted with the natural resources of these States can or does doubt the supply of the materials. Technical literature, Government reports, private and published data by the thousands of pages during the last fifty years have set forth the dominant wealth of this part of the nation so fully and so accurately that but little can now be added.

Whether it be petroleum, or salt, or sulphur, or phosphate rock, or clays, or iron ore, or naval stores, or by-products from coal, or what not, the possibilities within this area are practically limitless. There is scarcely a single thing in the long list of materials required for the prosperity of the nation that is not to be had here, and had in abundance, within easy reach of trunk lines of railroad.

WILLIAM BATTLE PHILLIPS born July 4, 1857, at Chapel Hill, N. C. Educated at Davidson College, the University of North Carolina and the School of Mines, Freiberg, Saxony. Chemist in the North Carolina Agricultural Experiment Station and for the Navassa Guano Company. On editorial staff of the *Engineering and Mining Journal*, New York, and editor of the *American Manufacturer and Iron World*, Pittsburgh. Professor of metallurgy and mineralogy, University of North Carolina, and of chemistry and metallurgy, University of Alabama. Chemist for the Tennessee Coal, Iron & Railway Company, Birmingham. Director of the University of Texas Mineral Survey and of the Bureau of Economic Geology and Technology. President of the Colorado School of Mines. Now in private practice in mining and technical processes, Austin, Tex. Member of the American Institute of Mining Engineers and of the Washington Academy of Science.

Supply of raw materials? Let us put this aside. There is no use in piling Pelion on Ossa.

The same may be said as to the second item, viz., cheap fuel or other source of power. The coal supplies in these States are very large, and practically untouched. Many of the larger and steadier water-powers have been or are being utilized, while others are under consideration. The success that has attended the transmission of high tension electric lines for more than 200 miles under severe climatic conditions—conditions that are seldom or never encountered in these States—has given a new and more substantial impetus to plans for the harnessing of water-powers now untouched and for the establishment of central power plants deriving their energy from cheap coal and lignite. When fuel, which will evaporate five pounds of water per pound of fuel, can be laid down at the factory for 65 to 75 cents a ton; when from a ton of this same fuel there can be obtained 50,000 cubic feet of producer gas of 125 to 140 British thermal units per cubic foot; when at the same time from a ton of this same fuel there can be obtained 50 pounds of sulphate of ammonia, to say nothing of tar and other products; when from this same fuel there can be made briquettes of a heating power of the best bituminous coal, briquettes that burn with as little smoke as anthracite coal, it would appear that the question of cheap fuel need not be discussed at length.

Fuel is really a raw material; it has to be transformed into something else before its latent powers are available, whether that something else is household comfort or industrial energy. A ton of coal represents so much energy locked up and awaiting technical skill for its development. It is not at all to our credit that we now utilize so little of the power within a block of coal, that so much goes to waste and so little for human use. Of all raw materials, it is the one from which we get the least. It should be the one from which we get the most, for it takes thousands of years to make a foot of coal. All of the vegetation on an acre of thickly-wooded land would make about an inch of coal over that acre. Coal should be our most profitable servant, but it has brought us into the habits of a spendthrift. There is so much of it that we waste it at a prodigious rate.

It is not so much the price paid for fuel that determines its cheapness as

the purposes to which it is put. We may pay a high price for coal if the things it enables us to produce are sold at correspondingly high prices. It may happen that coal at $3 a ton is really cheaper than coal at $1 a ton. It all depends on what we do with the coal, what proportion of its latent powers we make use of. The coals of the South and Southwest are so cheap that we think we can afford to throw away from 60 to 75 per cent. of their value; to use from 25 to 40 per cent. and waste the remainder.

It is in respect of things now going to waste, especially the things that can be made from coal, other than power, heat and light, that the chemical industry of the South, as indeed of the entire nation, is so far behind the requirements of modern life.

Power, heat and light from waterfalls can never be distributed over the area that coal reaches. Such sources of energy are cheap, extremely convenient and efficient, but those are the favored localities where such energy is available. There are not enough waterfalls to go around, so to speak. The development of the chemical industries of the South and Southwest will depend not on cheap electric power of hydraulic origin, but on cheap steam and electric power derived from coal and lignite. I am not throwing water on water-power, I am merely pointing out that the field of its usefulness is greatly restricted and that it cannot be depended on to supply the needs of more than a small part of the country at best.

There are certain industries, such as the manufacture of cotton, etc., that require cheap hydraulic power because of the cheapness of their products, just as there are also establishments, such as those making caustic, bleaching powder, carborundum, calcium carbide, artificial graphite, etc., that require large volumes of cheap current to produce their peculiar products. Cheap power does not always mean a cheap product, but the enlargement of the chemical industries of the South will depend on cheap power to offset the higher cost of labor (as measured by its efficiency) and the higher cost of transportation to larger and steadier markets. Improvements in the utilization of the energy within these cheaper fuels (and these look toward their gasification) will still further reduce their cost as measured by the cost of the end products.

Granted the abundant supply of raw materials and cheap fuel or other source of power, how is the necessary capital to be secured? By the enactment and enforcement of just and liberal laws, in the first place, and, in the second place, by lower rates of interest.

It may be indiscreet to say that the day of the small enterprise is passing, but it appears to be true that the small enterprise is finding it more and more difficult to secure money at rates that enable it to survive.

It would be vastly interesting and important to study the effect of lower interest rates on the building up of industrial enterprises. Daniel Webster used to remark on the power of 6 per cent., but 4 per cent. is far more powerful in causing the establishment of new ventures and the rehabilitation of old ones. Some of our States and cities do not seem to desire the influx of new people, new blood, new money, if one may judge from the laws and ordinances that are passed. While they may not be actively "agin" the corporations, syndicates, companies, etc., they are not actively for them. They look somewhat askance at them and seem to harbor suspicions that they will bear watching. All of this may be true, for organizations of men do not always behave any better than individuals. Here is where the law comes in, both for companies and for individuals, but it seems to me that the law should bear on company and individual alike.

A German banker once remarked at a public meeting held in Birmingham, Ala., that money was the most sensitive plant that ever grew in a garden. It is probably true, and for that very reason it must be cared for accordingly. It is sensitive, and it must be protected. Whether or no the slow growth of chemical industries in the South may be traceable, in part at least, to sentiments and laws unfavorable to investments of the kind I do not know, but I do know that this has been given as one of the reasons why capital has been withheld.

I shall not mention names, but within the last two years one of the influential members of a large organization told me that his company had found some excellent material in a certain Southern State, and material that they could make good use of, but that the laws of that State were such that he could not and would not do business there. No, it was not the Standard Oil Co., nor any member of an "octopus" strangling or otherwise. It was a business employing a very large number of men and deservedly famous throughout the country for its wise, just and liberal dealings.

I am aware that many storms of indignant protest have been aroused by remarks not unlike these and that "renegade," "false Southerner" and such like terms have been dished out with a free hand. It is all one to me. I happen to know what I am talking about, and there are others who could speak out if they would.

What we need, above everything else, are laws that will encourage the investment of capital, not hamper it; laws that will protect the investor without in the least impairing the dignity or authority of the State. We must cease to look upon the aggregation of capital as an evil in itself. It all depends on the use to which it is put whether it is an evil or not. If we need money for the development of our industries—and all the saints past, present and to come know that we do need it—we must conform to the usages under which it is invested elsewhere. I do not know of a more useful service that could be performed than an inquiry into the cost of the money that is building up industries all over the country. We talk a good deal about the cost of raw materials, of power, water, transportation, etc., but how about the cost of money? This determines the cost of everything else. With money at 8 per cent. many things are impossible that could be done with money at 4 per cent. Cheaper money means better protection for the money, and many an enterprise is languishing because of the lack of this protection.

Good business management is often an incentive to capital to embark upon an enterprise that may not be, for the moment, particularly encouraging. Economy, efficiency, simple and compact organization are the chief factors in good business management, and when these are apparent it is not difficult to secure financial help for an undertaking that may at the time be losing money. The mere fact that the business at any special time or even for a period of time is unprofitable is no insuperable bar to further credit. It all depends, as the saying is, and this dependence is often affected by circumstances beyond the control of the manager or the executive board. It is impossible for any of us so to plan and so to control that the results shall always be to our advantage. To attain success the general course of the curve must be upwards, but there are sure to be points where it will swing the other way.

The technical skill so requisite in the building up of chemical industries in the South may now be acquired in the South itself. It is no longer necessary for our young men to journey to Europe or even to other parts of our own country to secure excellent training in scientific matters, in chemistry, in chemical and mechanical and electrical engineering, and, above all, in the handling of labor.

The vice-president of one of the largest industrial concerns in the South said to me last year that he could get plenty of well-trained young men for the ordinary conduct of the business, but very few who could be promoted. He went on to say that there seemed to be something lacking in the training that was given in the technical schools throughout the country, a something that would give the young men an insight into the art of handling the labor they would certainly have to handle. Success in technical affairs is based not only on sound technical training, but also on the application of that training through human instrumentalities. It is the human machine that has to be used, and this machine is becoming more and more complicated, with the righteous demand for better living conditions, for a larger share in the profits of the business, for a more equitable distribution of the comforts and even the luxuries of life.

I do not propose to discuss the question whether the ordinary labor in the South and Southwest is of the sort to lend itself readily to the requirements of highly specialized industries. It may be as well adapted for such purposes as ordinary labor in other parts of the country, which is not saying overly much. But the factory atmosphere is to a large extent lacking, the pride of the family and the guild in doing the same kind of work year after year. This appears to give rise to a certain hereditary tendency and power to fit into a specialized organization so that the work is done with more speed, more accuracy and less effort.

There is another consideration that must be taken into account here, and that is, the disturbing effect of cheap lands upon industrial labor. I call to mind the experience of a large woolen mill, engaged chiefly in the manufacture of blankets. It is only within recent years that it has been able to keep its labor after training it for the purpose in hand. As soon as a sufficient "stake" had been acquired the call to ownership in the soil was imperative and the mill was exchanged for the farm and the truck garden. Cheap lands and highly-developed industries do not often go hand in hand, and I suspect that this fact has played an important part in the retardation of the triumph of the South in the industries that fall so naturally to her.

Lentulus and his legions are endeavoring to introduce sports hitherto unknown, and time must be allowed for their assimilation.

It is, perhaps, somewhat too early to venture an opinion as to the effect the increased interest in public school education is to have on public sentiment toward industrial pursuits. That it will have an important bearing on all public matters is beyond dispute, but just what course it will take is problematical. Political questions will come into play, for the establishment of industries that have hitherto been more or less dependent on the tariff will disturb existing sentiments.

We do not have to go back very far to observe the truth of General Hancock's aphorism with respect to the tariff, and we do not have to peer very far into the future to see that in respect of chemical industries we shall have to face very severe competition. The protection of American industries is not a political question, it is an economic one, and has to be settled, if at all, on economic lines. It does not concern itself so much with revenue for the support of the Government as with internal prosperity, with the building up in our own homes and lives, of a greater and more permanent sense of domestic security. America for true Americans is an infinitely better motto than any display "ad." on a tariff wall.

The question of transportation to available markets is one that will have to work itself out. There is sufficient domestic market for all of the chemical products that the South can produce, and there are enough railroads to handle them. There is a market for standard goods of uniform quality, but it is one that will have to be cultivated. There is a word of warning to be given, and that is, not to place on any market goods the quality of which cannot be maintained. It is fatal to any business to introduce products of a certain quality and then lower the quality. In the chemical industry this is particularly true. Goods of standard quality will bear a higher freight rate than those of a lower grade, and in looking for markets this factor of transportation must always be considered. It is not the cost of transportation, *per se*, that counts; it is the cost with reference to the value of the commodity. Quicksilver at $80 a flask can bear a higher rate than at $40 a flask, and high-grade chemicals can bear a higher rate than cheap cotton goods.

What are the chemical industries that should be developed in the South and Southwest?

It would appear that those industries which would supply the products most in use should receive the first attention. The South is chiefly agricultural. It uses very large quantities of commercial fertilizers, in almost every

known combination; large quantities of acid phosphates, sulphate of ammonia, nitrogenous manures, potash, etc. The by-product coke ovens at Ensley, Woodward and Tuscaloosa, in Alabama, supply a considerable proportion of the sulphate of ammonia now produced in this country, and the western trade will be supplied from the Koppers ovens to be erected at Pueblo, Col., by the Colorado Fuel & Iron Co.

But the fertilizer trade is not the only one demanding salts of ammonia. The use of anhydrous ammonia in ice-making opens a large field, as also the feasibility of employing crude sulphate of ammonia as the starting point for a long list of other products. In the distillation of coal we have gas, coke and tar. From the gas is made sulphate of ammonia, but have we considered the possibility of obtaining other products from this gas before it is used? From certain kinds of natural gas, carrying butane and pentane, large quantities of artificial gasoline are now produced, but not in any of the Southern States except West Virginia. Is it feasible to make gasoline from coal gas, whether by-product or retort? There are many interesting products made from coal gas by refrigeration and compression. Have we exhausted the possibilities of coal gas when we have taken from it the ammonia it contains? Are there no further products? And the phosphate trade. Are there no better products than the ordinary so-called acid phosphate? Our friends across the water have been making for many years a double superphosphate that carries more than 40 per cent. of phosphoric acid soluble in water. Are we making this?

Are there no improvements to be effected in the mining and treatment of phosphate rock before it is changed into acid phosphate? Cannot the cleaning and drying of the crude rock be done at less expense and more efficiently, let us say by the Goltra process as applied to brown iron ores, than by present methods?

As to potash. The present supplies in the country are wholly inadequate, but we are not supplementing them. What is done in Nebraska, in Utah and California is but a drop in the bucket. The potash-bearing lakes near Alliance, the alunite deposits at Marysvale and the kelp industry on the California coast may supply a certain limited potash market, but when it comes to the agricultural demand they are scarcely to be counted. Is American ingenuity, skill and patience to balk at the recovery of potash from beet-sugar refuse or from feldspar? There are enormous dumps of potash-bearing feldspar in the Cripple Creek district of Colorado on which the mining costs have already been paid. They are really and truly waste. They carry about 6 per cent. of potash, and are already in a finely divided condition. If there is any place in the country where experiments on a working scale for the extraction of potash from feldspar could be conducted under favorable conditions it is where the rock has already been mined and crushed.

As to sulphuric acid, without which the entire fertilizer trade is helpless, what may not be done with the sulphur deposits in Louisiana, at the mouth of the Brazos River and in Culberson county, Texas? If there is any one thing upon which chemical industries depend it is sulphuric acid, and the South and Southwest contain very large supplies of pyrite and native sulphur. This part of the country contains practically all of the phosphate rock that is used and all of the deposits of native sulphur.

The South and Southwest contain also very large deposits of iron ore, practically all of the so-called brown-ore deposits now worked in the United States. Cheaper iron and better iron and steel are made from these ores than from the red hematites (Clinton ores), and yet they are not mined in anything like the quantities their merits deserve. They are prepared for market today in almost the same manner that they were prepared thirty to fifty years ago. There are wonderful improvements possible in this direction. More than two years ago the writer tested fourteen cars of low-grade iron ore from northeast Texas at Waukon, Iowa, by the Goltra process for dispensing with water in the concentration of such material. The crude ore carried 32 per cent. of iron and we succeeded in raising 46 per cent. of it up to 54 per cent. of iron, with some of the magnetized material going as high as 63 per cent. of iron. The finished ore contained no water at all, whether hygroscopic or combined, and was open and spongy, in the best possible condition for the blast furnace.

There are many brown-ore deposits in Virginia, Tennessee, Kentucky, Georgia, Alabama and Texas that are lying idle today because of the impossibility of applying to them the old-fashioned methods of concentration. It is a problem both chemical and mechanical, and one that invites the investment of capital with peculiar force. The product to be obtained has a ready and stable market, for calcined brown ore carrying more than 50 per cent. of iron is eagerly sought for. When one goes into some stockhouses and sees the wretched condition of the brown ore used he wonders why iron-makers continue to employ it. The brown ore produced by the Goltra process is in every respect far superior to any other brown ore used in the United States. This process can be applied to brown-ore "banks" that cannot be worked by old-fashioned methods.

The possibility of recovering valuable by-products from blast furnace gases, such as compounds from which potassium cyanide may be made, is a question that any technical chemist should be proud to tackle. The recovery of these compounds need not interfere at all with the subsequent use to which this gas is used, i. e., under the boilers, in heating the stoves or in gas engines.

There were some who said that it was impractical to freeze the moisture out of the air going to the hot blast stoves so as to deliver dry air to them, but Gayley thought otherwise, and it was done. It is idle to say that a thing cannot be done if there exists an economic reason why it should be done. We often use the term "waste product" through indifference or sheer ignorance. I sometimes question if there is any such thing as a "waste product," so wonderfully have chemists found ways and means for utilizing what their fathers threw away.

The clays of the South and Southwest have been sadly neglected from a technical standpoint. There are kaolins in these States, especially in Texas, that are far superior to any other clays in the country, and yet the shipments are negligible. Some of these beautiful kaolins have a small amount of oxide of iron which interferes with their highest value. In some cases it has been found to be very difficult to remove this oxide of iron, but as the kaolin when once freed from this ingredient has a selling price of $25 to $35 a ton, it would appear that chemistry and mechanics have here a most attractive field.

The manufacture of acid-proof and alkali-proof cement should be largely developed in the South and Southwest, for the raw materials exist in vast quantities and the demand for this kind of cement is steadily increasing. The same observation applies to hydrated lime, and, in a less degree, to sand-lime brick.

The Southwest is a large producer of petroleum, and it is interesting to know that one of the new processes for increasing the yield of gasoline and other substances of low boiling point from crude oil is being tried out by a refining company of ample means. Researches into the composition and use of the so-called synthetic drying oils have been under way for some time. Some of the more progressive companies maintain research laboratories and a full staff of experienced chemists. In view of the increasing demand for gasoline, due to the ever-growing automobile trade, the use of a fuel closer to kerosene than gasoline should be an attractive study. This is another illustration of the close connection between chemical and mechanical industries. In the design of internal combustion engines to use a fuel of higher vaporization point than gasoline the chemist and the mechanician must work hand in hand.

Speaking of gasoline. It is noteworthy that some of the natural gases from the Southwest field are capable of yielding as much artificial gasoline as the gas from West Virginia, 2½ to 3 gallons per 1000 cubic feet. Not all natural gas yields artificial gasoline, but only such as contain butane and pentane.

A new feature has been added to the naval stores trade within the last year or two, and that is the manufacture of oils for the oil-flotation process as applied to the concentration of ores of gold, silver, copper, lead and zinc. The concentration of such ores is almost entirely confined to the West, where the only flotation oils produced are coal-tar oils. There is, of course, competition between the mineral oils and the vegetable oils, and each kind of oil has its adherents. In bulk this trade is not very heavy, seeing that it takes only from one to one and a half pounds of oil per ton of ore treated, but as some of these oils bring from 30 to 40 cents a gallon, the industry is worth cultivating.

The South and Southwest have large deposits of fuller's earth, used in the bleaching and refining of animal, vegetable and mineral oils, but, with the exception of the Florida deposits, this material does not come much into use. The deposits in Texas are large, and some of them are of excellent quality, especially for the bleaching of cottonseed oil. There is a fine field here for chemical research, and it has been much neglected. We know but little about the qualities of a fuller's earth that adapt it to its several uses, nor why certain earths have a tendency to cause spontaneous combustion in the material from the filter presses, nor why a disagreeable odor sometimes accompanies the employment of a particular earth. The literature on fuller's earth is meager and unsatisfactory, and we are still much in the dark concerning its essential nature and the changes that it occasions in oils and to which it is itself liable. It would appear that studies in colloidal chemistry would be fruitful of results in respect of fuller's earth.

The deposits of salt in the Southwest, especially in Louisiana and Texas, are extensive and easy of access. As some of them occur near deposits of limestone, it would seem that there are favorable localities for the etsablishment of chemical industries using these materials.

The production of nitrogen compounds from atmospheric nitrogen appears now to be limited to such localities as have very cheap electric current, hydro-electric plants. There are many such places in the South along the larger rivers in West Virginia, Virginia, North and South Carolina, Kentucky, Tennessee, Georgia and Alabama. With lignite at 75 cents a ton there might be an opportunity for the generation of high tension electric current otherwise than by water-power, especially when one considers the recovery of sulphate of ammonia and tar at the same time. The larger and steadier water-powers may not be the only source of electric power so cheap as to be used for a great many purposes not at present under serious consideration.

I have in mind now a central power plant situated immediately at a lignite mine. It is selling electric power for two cents per kilowatt hour over distances of 50 miles. With a more modern equipment and with a larger market the price could be reduced to one cent per kilowatt hour. In a large ore concentrating investigation now in hand we are paying five cents per kilowatt hour for hydro-electric power brought for 165 miles across the mountains. If we used considerably more power the price would be two and one-half cents per kilowatt hour. I believe that there are places in the Southwest where an up-to-date central power plant could do a large and profitable business selling current at one cent per kilowatt hour, conveying the current over a radius of 100 miles.

Cheap and steady electric current means the building up of many chemical industries throughout the South and Southwest. I am not decrying the use of steam or water-power, but the former, under ordinary conditions, cannot compete with electric power, and the latter is possible only in the more favored areas.

In this brief review of some of the conditions that maintain in the South and Southwest with respect to the development of chemical industries, I have necessarily omitted many minor but none the less important references. They will present themselves to anyone who has kept in touch with the events of the last years, and who has something of a prophetic vision.

Tyndall was wont to speak of the scientific use of the imagination. The really great men are those who can see what must come and who can prepare for it. It may be that they themselves bring it about. If so, they are still greater.

Wm. B. Phillips.

Potash as a By-Product in the Cement and Iron Industries.*

By Ernest F. Burchard, United States Geological Survey.

THE Manufacturers Record has already, by means of a number of timely articles, attracted wide attention to the possibilities of profitable potash recovery in two of the nation's greatest manufacturing industries. Four Federal bureaus have begun inquiries or studies bearing on the subject, and it is evident that its importance to the nation will insure its being thoroughly investigated by public and private agencies.

E. F. BURCHARD.

POTASH FROM CEMENT MANUFACTURE.

The collection or elimination of dust in the cement plant is one of the most important problems in cement manufacture at present, and incidental to the study of this problem the year 1915 witnessed an awakening of interest on the part of several cement companies to the possibility of recovering potash as a by-product in cement manufacture. The pioneer in this field was the Riverside Portland Cement Co., the plant of which is at Riverside, Cal. The early efforts of the Riverside Company, which employs the Cottrell electrical precipation process,† were directed rather toward precipitating waste dust than toward recovering potash, but the company soon discovered that, although the raw mix contained only about 0.2 per cent. of potash, the dust contained potash in considerable quantities, and a large portion of it is now being recovered. Since the supply of potash from Germany has been cut off, the Riverside Company has contracted for the sale of its potash at prices that yield large returns on the investment for the dust-collecting equipment.

The Western Precipitation Company of Los Angeles, Cal., controls the license for all applications of the Cottrell precipitation process to cement manufacture. This company reports that it has made analyses of a large number of samples of raw mix used by cement mills in the United States, and finds that the potash content of the raw mix used at Riverside is much lower than the average. This affords encouragement for the hope that the problem of potash recovery may be more generally undertaken by cement manufacturers in the near future.

The high prices for potash that have prevailed since the shortage began to be felt have, of course, stimulated many and diverse efforts to discover or devise a domestic source of potash, and the first plant in the South to follow the lead of the Riverside plant is that of the Security Cement & Lime Co., at Security, near Hagerstown, Md. The limestone used by the Security Company in making Portland cement contains more than the average percentage of potash (K_2O), a fact which lends encouragement to the effort to recover it at this plant. A commercial output of potash is now being obtained here.

A description of the plant at Security, Md., has been published in the Manufacturers Record.‡

A process in which it is proposed to reverse the order of products and make cement as a by-product from potash has been outlined in recent publications.§

After several years of investigation and experimentation a commercial plant designed to produce 20 tons per day of potash salts from feldspar and limestone, with hydraulic cement as a by-product, is being constructed at Buffalo, N. Y. A yield of 1000 barrels per day of cement are expected. Crushed limestone and feldspar or other potassium silicate rock are thoroughly fused in a furnace and maintained at a temperature of 1300° C. until the potassium salts are volatilized. The volatilized salts pass into the furnace gases which are utilized for producing steam in the waste heat boilers. When these gases have cooled to about 400° C. they are passed through Cottrell collectors, which separate out most of the potash salts, and the remainder are saved by a washing process. The molten mass from which the potash salts have been volatilized flows from the furnace, is granulated, and treated with solutions of certain salts. This granulated clinker is then ground and mixed with a small percentage of gypsum or other material for regulating the set, and is then ready for use as a cement. This is known as the Brown process, the patents having been issued to H. E. Brown.

The Portland cement industry in the United States showed a phenomenal growth from 1895 to 1913, but in 1914 it experienced a slight check, and made only a slight recovery in 1915, so it seems very fortunate that just at this time the possibility of recovering potash as a by-product in cement manufacture should be realized. It means a new stimulus to a giant industry that otherwise seemed to have about reached its maturity. It has been suggested that in the future new Portland cement plants may be located at places where the limestone carries the highest percentages of potash. It is probable that location with respect to supplies of the basal raw materials, limestone and clay, shale, or blast-furnace slag, fuel, good shipping facilities and proximity to markets will continue to be the most important features, but between two localities where the conditions are about on a par the presence of potash in greatest quantity in the raw materials would undoubtedly prove the controlling factor, and it may develop into still greater importance. There is, however, the possibility that processes will be perfected whereby materials high in potash, such as feldspar, sericite and greensand, may yet be made to yield their potash in the portland cement kilns, and that it will prove more advantageous to bring them to the plant than to ship the more bulky cement a greater distance.

CEMENT MANUFACTURE IN THE SOUTH.

In order to show the especial bearing of this discussion on the cement industry in the Southern States, it is essential to introduce some statistics concerning the output and consumption of cement in the South, compared with those of the United States, to indicate the obvious commercial advantages possessed by many cement-producing localities in the South, and to outline some geological facts concerning the distribution of raw cement materials and fuels in the South.

Production—Portland cement is manufactured by 21 plants, situated in 10 of the 16 Southern States. The output of these plants represents about 17 per cent. of that of the United States as a whole. In the majority of the Southern States there was an increase in shipments of Portland cement in 1915 compared with 1914, and the net change for all the 10 producing States was an increase. This is encouraging as indicating a rapid recovery from a year of depression, and also because the percentage of increase was nearly 10 times greater than that of the whole United States. These data are shown in one of the accompanying tables.

Portland Cement Shipped from Mills in the Southern States, 1914 and 1915.

	Active plants.		1914.		1915.	
	1914.	1915.	Barrels.	Value.	Barrels.	Value.
Maryland, Virginia and West Virginia	4	4	2,793,036	$2,449,493	3,166,721	$2,584,044
Tennessee, Alabama and Georgia.	5	5	2,577,099	2,409,588	3,090,770	2,343,426
Kentucky, Missouri, Oklahoma and Texas	12	12	8,339,372	8,541,481	8,083,860	7,832,135
Total	21	21	13,709,507	$13,400,562	14,350,351	$12,759,605
Total of United States	111	109	86,437,956	80,118,475	86,891,681	74,756,674
Southern States' percentage	19.	19.	16.	17.	17.	17.

Estimated Per Capita Consumption of Portland Cement in the Southern States and in the United States and Outlying Possessions in 1914 and 1915.

	1914.			1915.		
State.	Population (estimated).	Consumption (shipments to States). Barrels.	Estimated consumption per capita. Barrels.	Population (estimated).	Consumption (shipments to States). Barrels.	Estimated consumption per capita. Barrels.
Alabama	2,269,945	517,405	.23	2,301,277	384,563	.17
Arkansas	1,686,480	409,607	.24	1,713,102	276,756	.16
District of Columbia	353,378	341,227	.97	358,679	441,417	1.23
Florida	848,111	460,974	.54	870,802	483,039	.55
Georgia	2,776,513	511,385	.18	2,816,289	617,124	.22
Kentucky	2,350,731	874,538	.37	2,365,185	827,909	.35
Louisiana	1,773,482	583,159	.33	1,801,306	776,177	.43
Maryland	1,341,075	1,624,180	1.21	1,351,941	1,367,732	1.01
Mississippi	1,901,882	206,782	.11	1,926,778	194,319	.11
Missouri	3,372,886	2,940,638	.87	3,391,789	2,892,781	.85
North Carolina	2,339,452	529,643	.23	2,371,095	570,472	.24
Oklahoma	2,026,534	508,233	.25	2,114,307	671,714	.32
South Carolina	1,590,015	176,693	.11	1,607,745	272,115	.17
Tennessee	2,254,754	802,711	.36	2,271,379	736,397	.32
Texas	4,257,854	1,821,628	.43	4,343,710	1,741,228	.40
Virginia	2,150,009	1,008,492	.47	2,171,014	1,178,465	.54
West Virginia	1,332,910	1,250,557	.94	1,359,474	1,067,967	.79
Total	34,626,011	14,558,852	.42	35,135,872	14,500,175	.41
Total for the United States	108,889,493	84,298,151	.77	110,755,853	84,663,583	.76

Consumption—The next thing to consider is what the relationship is between production and consumption of cement in the South. Statistics of shipments to Southern States show that in 1914 the South consumed about 850,000 barrels more cement than it manufactured, and in 1915 it took only 150,000 barrels more. Not a wide margin—not enough to warrant the building of a new cement mill without cutting into the trade of other established plants. But

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†Schmidt, W. A., Cottrell processes of electrical precipitation: Canadian Min. Inst. Trans., vol. 18, pp. 110-133, 1915.

‡Recovery of potash at Security cement plant: Manufacturers Record, May 11, 1916, pp. 44-45.

§Hydraulic cement is a by-product of potash plant: Cement and Eng. News, May, 1916, p. 114; also Concrete Age, May, 1916, p. 21.

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this is not all the table shows. It shows that the per capita cement-consuming power of the Southern States is as yet only about 54 per cent. of that of the United States as a whole, or, where .76 barrel of cement is consumed per capita in the United States in 1915, the average per capita consumption of the Southern States is .41 barrel. This should afford encouragement to the cement manufacturer and the cement salesman as showing that there is room in this field for more educational work to show the advantages of using cement and concrete.

EXPORTS.

In 1915 the hydraulic cement exported from the United States to foreign countries, including the Philippines and the Panama Canal Zone, was 2,565,031 barrels, most of it Portland cement, valued at $3,361,451 at the United States ports of shipment, an average of approximately $1.31 a barrel. The quantity exported in 1915 was not quite 3 per cent. of the total production of hydraulic cements. The exports have never been great, the largest quantity, that in 1912, having been only 4,215,532 barrels. The exports for 1915, however, showed an increase of nearly 20 per cent. over those of 1914, and as this increase was due largely to greater exports to South American countries and the West Indies, it appears that the cement trade is expanding in the direction of the greatest promise, especially to mills in the Southern States that are convenient to tidewater. There were relatively large increases in exports to Brazil, British Guiana, Barbados, Jamaica, Trinidad and Tobago Islands, Chile, the Dutch West Indies, Ecuador, Mexico, Peru, Salvador and Uruguay. The building up of an export trade in Portland cement offers great possibilities to southern mills. That this has been recognized is shown by the fact that the Texas Portland Cement Co. early in 1916 completed a new mill on tidewater at Houston, Tex.

PORTLAND CEMENT MATERIALS IN THE SOUTH.

The distribution of cement-making limestone, clays and suitable kiln fuels in the Southern States has been discussed and illustrated by a map in an earlier issue of the Manufacturers Record,* so only a brief mention of these resources need be made here. The limestones suitable for making Petroleum and natural gas occur in abundance in Oklahoma, Texas, Arkansas, (early geologic) age, the softer chalks of Mesozoic (middle geologic) age and the little consolidated shell marls of Cenozoic, or comparatively late geologic age. The Paleozoic limestones are widely distributed through the Appalachian valleys of Maryland, the Virginias, East Tennessee, Georgia and Alabama, in the central portions of Kentucky, Tennessee and Texas, and the Ozark region of Missouri, Arkansas and Oklahoma. The chalky limestones are found in eastern Texas, northern Louisiana, southern Arkansas and in belts crossing the States of Mississippi, Alabama, Florida and extending into Tennessee on the northwest and Georgia on the southeast. The shell beds are found in the coastal plain region of Virginia, the Carolinas, Georgia and Florida. Beds of shale or clay are found in all the areas, some of them interbedded with limestones and other rocks, and some residual from the disintegration of limestone.

Bituminous coal areas border the limestone belts in the Appalachian States and in Missouri, Oklahoma and Arkansas. Lignite, possibly of use for steam fuel, is available in Texas, Arkansas, Louisiana, Mississippi and Alabama. Petroleum and natural gas occur in abundance in Oklahoma, Texas, Arkansas, Louisiana and West Virginia, and may be found in other States as a result of explorations in progress.

So, without going further, it is very apparent that the South possesses the potential resources for a greatly enlarged cement manufacturing industry, and if the chemists will study carefully these limestones, shales and clays, there is little doubt that many deposits will be found equally rich in potash as the beds at Security, Md.

As to the distribution of feldspar in the South, Katz‖ reports that a belt extending southwest through Harford, Baltimore, Howard and Montgomery counties, Maryland, contains a great number of large, high-grade pegmatite dikes, which are quarried in many places, and which supply a large proportion of the feldspar consumed in the United States. The Piedmont province in Virginia, North Carolina, South Carolina, Georgia and Alabama and much of the Appalachian Mountain province are occupied by rocks in which pegmatite dikes are widely distributed. Some of these have been worked for feldspar, and many more have been developed for their content of kaolin, mica and gem minerals; these latter give promise of supplying feldspar also. In Virginia an area in Bedford and Henry counties, and another in Amelia and Prince Edward counties, have been commercial producers of feldspar. In North Carolina the spruce pine district in Avery, Mitchell and Yancey counties annually produces a large quantity of feldspar. The regions of Iredell, Lincoln and Cleveland, and of Jackson, Macon and Swain counties are particularly promising for feldspar production. In South Carolina some feldspar has been produced in the neighborhood of Pacolet, in Spartanburg county. There has been no production of feldspar in Georgia or Alabama. In St. Genevieve county, in the Ozark regions of Missouri, there are pegmatite dikes containing feldspars of good grade, but there has been no commercial development in this region. In Llano and Burnet counties, Texas, there are pegmatite dikes which may become a source of feldspar. Not all these feldspars contain potash, but most of those that are mined are of the potash variety, and may contain up to 13 per cent. K_2O.

ADVANTAGES POSSESSED BY THE SOUTH.

To summarize, the supplies of raw material are inexhaustible and most advantageously located; abundant supplies of high-grade fuel are closely associated with them; excellent quarrying and manufacturing sites are to be found along the railways and rivers; water supplies and water-power are abundant, and economical electric power is being developed. Transportation facilities, including river navigation and Atlantic and Gulf harbors, are being improved. Export trade has been facilitated by the opening of the Panama Canal, and now that to the by-products of cement manufacture, such as crushed rock and chemical limestone, may possibly be added the very valuable potash, there is, in deed, a bright future for cement manufacture in the South.

POTASH FROM IRON MANUFACTURE.

In the field of iron manufacture there is as yet no actual experience in the recovery of potash upon which to draw, as in the cement industry. The recent article by Charles Catlett† is, however, so replete with suggestions of great interest and promise to the chemist and metallurgist that the writer, who has been making studies of the iron-ore resources of the South for several years, feels that perhaps the way has at last been pointed out by which vast reserves of ore, whose grade is at present a little below par in a commercial sense, may be made of value. In pointing out the variability in iron-ore composition, Mr. Catlett makes the reassuring statement that the leaner, more siliceous ores are apt to be higher in potash. In support of this generalization Mr. Catlett cites certain analyses of gray iron ores near Talladega, Ala. The gray ores may well be suspected of carrying relatively high percentages of potash, because the gangue comprises certain metamorphic minerals which carry potash, such as feldspars and mica.

Unfortunately, there are few analyses sufficiently complete as to show the potash content in iron ore. Mr. Catlett mentions published analyses (source not given) which show between 1.50 and 2 per cent., and one showing over 2 per cent. [potash?]. The writer finds published‡ analyses of three samples of these gray ores which show the combined potash and soda to range from 1.57 to 2.11. Inasmuch as the feldspar present is largely a soda-lime feldspar, it is possible that there may not be as large a percentage of potash present as at first glance seems evident. However that may be, there is probably enough potash present to render the ore of great promise in this connection, particularly since there are large reserves of these gray ores still undeveloped.

The Clinton iron ore, a red hematite, is found in many parts of the United States. It occurs near Clinton, N. Y., whence its name; in Wisconsin, Missouri, in eastern Canada, and attains its greatest development in the Southern Appalachian region. This ore, of Silurian age, occurs in beds varying in thickness from an inch to 30 feet, interstratified with shale, sandstone and thin limestone.

Important deposits are found in southwest Virginia, east Tennessee, northwest Georgia and northeast Alabama. Among the localities where mining is active today are the Boones Path mines, in Lee county, Virginia; the LaFallette mines, in Campbell county; the Rockwood-Cardiff mines and the Chamberlain mines, in Roane county, Tenn.; the Estelle mines, in Walker county, Georgia; the mines at Attalla and Gadsden, Etowah county, and the many large mines of the Birmingham district, Jefferson county, Alabama.

Nearly all these are underground mines. In former years open-cut mining was carried on along the outcrop of the ore beds, and these old, abandoned trenches may be observed practically all the way from below Birmingham to Big Stone Gap, Va., in many places showing several parallel trenches where there were two or more beds of ore, or where one bed had been repeated by folding or faulting. In some places the ore beds were not more than one foot thick, and, of course, as soon as they were cut back to heavy cover, they were abandoned, and only the thicker beds were mined underground. Under present conditions an ore bed less than 2 feet thick cannot be mined profitably underground, and unless it is rich ore, it must be more than 2 feet thick in order to be considered.

The following six analyses of Clinton ores, showing the potash content, have been made by the United States Geological Survey:

Analyses of Clinton Iron Ores from Alabama and Tennessee.

	1	2	3	4	5	6
Silica (SiO_2)	5.00	7.92	7.62	7.63	7.56	27.67
Alumina (Al_2O_3)	2.82	3.07	4.31	3.64	4.14	10.39
Iron (Fe)	27.22	37.32	52.55	50.79	37.87	29.51
Manganese (Mn)	.30	.33	.31	.58	.05	.03
Titanium dioxide (TiO_2)	.11	.10	.12	.26	.41	.62
Lime (CaO)	24.84	13.77	.40	1.68	12.52	5.93
Magnesia (MgO)	1.63	1.71	.47	.50	..	..
Phosphorus (P)	.43	.57	.53	.73	.31	.37
Sodium oxide (Na_2O)	.10	.10	.13	.12	..	..
Potash (K_2O)	.22	.25	.30	.33	.17	2.56
Sulphur (S)	.05	.05	.02	.07	..	..
Carbon dioxide (CO_2)	19.89	12.29	.32	3.04	..	..
Water (H_2O)	5.61	6.11	10.11	8.99	..	..

1. Hard ore, Chamberlain, Tenn.
2. Semi-hard ore, Chamberlain, Tenn.
3. Soft ore, Chamberlain, Tenn.
4. Soft ore, Chamberlain, Tenn.
5. Hard ore, Greasy Cove, Ala.
6. Lean, shaly, hard ore, Crudup, Ala.

The writer has traced practically all these Clinton beds throughout the length of their outcrops in the four Southern States, and has been impressed with the great extent of the beds that fall just below the present workable grade either in thickness or in composition. Included in this classification are beds carrying shale intimately mixed with the hematite in the form of thin partings, lenses and minute concretions. Such ores are very difficult to free of shale, except by crushing finely and washing processes that are at present too costly. Another type of lean ore is that containing much free

*Burchard, Ernest F., Portland cement resources and industry in the Southern States: Manufacturers Record, Mar. 27, 1913, Pt. 2, pp. 69-71.

‖Katz, F. J., Feldspar in 1915; Min. Res. U. S. 1915, U. S. Geol. Survey, 1916, pp. 48-49.

†Catlett, Charles, The blast furnace as a potash producer; Manufacturers Record, May 11, 1916, pp. 41-42.

‡Smith, Philip S., The gray iron ores of Talladega county, Ala.: U. S. Geol. Survey Bull. 315, 1907, p. 177. (Cited from B. Crowell.)

silica in the form of fine to coarse sand. This sand is often coated with hematite, and the ore containing it has also to be finely crushed and washed to effect a separation of the iron oxide and silica. Various experiments have been made, involving the use of heavy liquids and air separation methods, but none has proved commercially practicable. Therefore, if the potash content of these leaner ores proves to be uniformly higher than that of better-grade ores, and it proves possible economically to separate the potash salts, such as potassium cyanide, in the blast furnace gas, then the possibility of making use of these lean ores within the present generation seems far more encouraging than otherwise.

All these analyses show some potash, most of them only a small fraction of 1 per cent., it is true, but one of them, No. 6, shows 2.56 per cent. The first five samples represent hard to soft ores, containing little or no shale. Number 6 is typical of the lean, shaly ores that have a wide extent in the Chattanooga region. Crushing and washing might reduce the silica and alumina appreciably, the potash slightly, and increase the iron content, but the process would be expensive, and no one has yet believed that it would pay. Here, then, is a problem for the blast-furnace chemist and metallurgist. If the potash in these shaly ores can be recovered, it should make available as an ore of iron a tonnage of material far in excess of the great total now already credited to the South.

The center of one of the shaly belts of Clinton ore is near Chattanooga, Tenn., and this city would be a logical place at which to try out the potash recovery process, in connection with one of the local blast furnaces. In the very middle of the Birmingham (Ala.) district are deposits of sandy ore about 16 feet thick, and there are large quantities of shaly ore adjacent to the city in West Red Mountain, and also in the northeast and southwest extremities of the district. With many blast furnaces in the district, Birmingham also would seem to be a favorable locality for the development of potash recovery. The gray ores of Talladega county are excellently situated with regard to blast furnaces at Ironaton and Anniston.

E. T. Buckard

Utilizing Our Raw Materials at Home.

By Joseph Hyde Pratt, Ph.D., State Geologist of North Carolina.

THE country's interest in conservation began about ten years ago, and one result of this agitation for the conservation of our natural resources has been a very wide investigation of the utilization of so-called waste products. Instead of throwing them away we are devising uses for them so that they will become profitable. This has been largely the work of the chemist and metallurgical engineer, and during their investigation of waste products they have at the same time taken up a more intense utilization of our raw materials.

Greater progress has been made along these lines in every other portion of our country than in the South, and yet I do not believe there is any section of this entire country that offers greater opportunities for the development of manufacturing industries that will utilize raw materials and waste products than the Southern States. The natural resources of the South are perhaps of greater variety than in any other section.

The South offers to the chemist an unparalleled field, and, while we realize the great service the chemist and metallurgical engineer can render us, the South at the same time offers many profitable investigations to these men. One of the reasons, perhaps, why we have not had as great a development in the utilization of our raw materials at home and more thorough investigations regarding their utilization and the saving of our waste products has been the very high freight rates which many sections of the South have had to contend with. These, however, are gradually being adjusted.

The mineral development of the South has made very rapid progress in the past 25 to 30 years, but the manufacturing industries dependent upon these minerals for their raw products have lagged way behind. The South has followed in the development of its mineral industry in very much the same path that it did in connection with its cotton industry; that is, producing the raw product, shipping this outside where it would be manufactured into products that were in turn shipped back for consumption.

Today we are shipping out of the South a great deal of raw material which is used in the manufacture of products that we are using in large quantities. When we consider the enormous water-powers that the South is capable of developing, which can be used to very great advantage for manufacturing purposes, it does seem strange that we have not taken up more energetically the question of utilizing our mineral and other raw products instead of shipping them to outside points.

FELDSPAR.

The feldspar deposits of the Southern States are of particular interest from three standpoints: One, as a source of raw material to be used in the manufacture of pottery; two, as a source of supply of potash; and three, as a source of fertilizer when in a finely ground state.

The potash feldspar is the variety for which there is the greatest demand, but the soda feldspar also has certain commercial uses. The deposits of these minerals in the South are just beginning to be utilized, but for the most part the raw materials are shipped outside the States. Virginia, North Carolina, South Carolina and Georgia contain deposits of feldspar, some of which are now being operated. Others contain the mineral in quantity and are worthy of investigation.

The Southern States are extremely interested in the production of potash salts, inasmuch as a very large part of these salts are used in the manufacture of fertilizers that are consumed in the Southern States. With the cutting off of the supply of these salts from Germany, due to the European war, this country has been obliged to take up seriously the question of manufacturing such salts from certain raw products that are available here. Certain minerals were known to contain potash (K_2O) in some quantity, such as feldspar and certain forms of muscovite mica. These minerals often contain 10 per cent. and better of potash, and processes have been devised for its extraction. If other commercial products could be obtained from the feldspar in connection with the extraction of the potash, the method derived for its extraction would probably be economical and profitable, but it is doubtful if it can be made successful for the extraction of the potash alone, unless there is considerable increase in the value of this product. Feldspar and muscovite mica deposits containing 10 per cent. and over of potash occur in considerable quantity in Virginia, North Carolina and Georgia. A large proportion of the potash salts is used in the two latter States.

Feldspar has also been experimented with in regard to its use as a fertilizer when very finely ground. It is well known that in the alteration of feldspar to kaolin the potash is converted into a soluble salt and leached out, and it is probable that with a very finely ground feldspar reactions may take place which would make the potash available for plant growth within a reasonable length of time.

Inquiries have been received at the Geological Survey office of North Carolina from a New York firm in regard to obtaining 400,000 tons or more of feldspar containing 10 per cent. and over of potash.

QUARTZ.

There is associated with the mica and feldspar in the pegmatitic dikes of the Southern Appalachian region a great deal of very pure quartz which should be suitable for the manufacture of glass. With the water-powers available in the localities where this quartz occurs, it is not improbable that electric furnaces could be developed that could be used to advantage in this manufacture. The Carolina, Clinchfield & Ohio Railway, which penetrates the district, offers very favorable railroad facilities.

Certain varieties of glass have nearly doubled in price since the outbreak of the European war. This is true of glass that is suitable for photographic purposes. These conditions make very desirable the investigation of the establishment of plants for the manufacture of glass near the source of the raw product and at places where electric power could be developed from water-power.

Quartz—or, as it is often known, silica—is used for a great many purposes besides the manufacture of glass, such as pottery, paints, polishes, scouring soaps and wood fillers. For certain of these purposes, such as glass and pottery, the quartz must be comparatively free from foreign substances, and especially the quartz used in the manufacture of glass must be free from any oxides that would in any way discolor the glass. For other purposes the value of the quartz depends on the character of the grain of the crushed or natural product. For some purposes, such as the manufacture of paint, soaps and polishing powders, the ground quartz gives much more satisfactory results than the fine natural quartz sand, on account of its being a purer white color and its grains being more angular and with sharp edges.

Massive quartz is used as a filler for acid towers and also as a flux, particularly in copper smelting. For this latter purpose the quartz does not have to be a pure product.

Several products are made from quartz in the electric furnace, such as tubes, crucibles and dishes used in chemical laboratories, silicon and alloys of silicon. Certain of the Southern States, as Virginia, North Carolina and Georgia, particularly North Carolina, contain large deposits of very pure quartz that could be utilized in the manufacture of many of the products mentioned above. Water-powers for developing electric power are available in nearly all the districts where the quartz occurs. Railroads also cross these districts, thus offering good transportation facilities.

CLAY PRODUCTS.

North Carolina and Georgia produce some of the finest kaolin to be found in the world, but at the present time all of this material is being shipped out of these States into New Jersey, Maryland, Pennsylvania and Ohio to be

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utilized in the manufacture of various products. Some of the kaolins which occur in large quantities do not burn pure white, but it is believed that investigations will show that they can be purified and thus make a better quality of clay.

North Carolina, Virginia and South Carolina produce potash-feldspar, which is used in the manufacture of pottery. Quartz is also found in quantity in several of these States, either associated with the feldspar or in close proximity to it, and thus we have in the South all the products necessary for the manufacture of various lines of pottery and porcelain, but at the present time we are shipping all these raw products outside of the Southern States and importing porcelain and other products manufactured from them. With its great variety of clays and other raw products, the South should be developing a pottery and porcelain industry of very large proportions.

At the present time the total value of the pottery production of the Southern States, with the exception of Louisiana, amounted in 1914 to approximately $226,000, and consisted of red earthenware, stoneware, turpentine cups (Tennessee), filters (Texas) and tobacco pipes (Virginia). These products represent the cheaper and lower grades of pottery. The production from Louisiana was of the famous Newcomb artware. There was also a small amount of art pottery, known as Nonconnah, made in North Carolina, and also a small amount of art pottery in Arkansas. The South should be able to develop several lines of art pottery additional to those mentioned above. It should also be manufacturing porcelain electric supplies, sanitary ware, whiteware, etc.

On account of the European war there is a shortage of kaolin and ball clay, and this is causing a renewed interest in several locations of these materials in the Southern States, and I believe upon investigation it will be found that these can be developed as sources of supply. Such deposits occur in Kentucky, Tennessee, North Carolina, Georgia and Florida.

There has always been a feeling that European ceramic wares were of a better quality than could be made by American manufacturers. Since the outbreak of the war many users of these wares have been obliged to accept goods made in this country, and if our manufacturers will pay close attention to maintaining a uniform quality of products and will make a determined effort to turn out goods that are equal in quality and efficiency to the European, I believe that they will be able to successfully compete for the ceramic business of this country.

The Southern States are producing a very large quantity of common brick, but a large proportion of these brick are of inferior quality, due to poor manufacturing methods. A few of the States are producing a considerable quantity of face brick; but very few of the fancy, ornamental and enamel brick are produced, and nearly all that are used are imported, although I believe they have the raw products in quantity suitable for these varieties of brick. There has never been a sufficient amount of experimental work done to determine for what particular varieties of brick the clays are adapted. Considerable experimental work is necessary in testing the clays and mixtures of clays and coloring material to determine what is the best use of the clay. This should open a wide field of investigation, with good chances of commercial success.

CEMENT.

Of the hundred or more Portland cement plants located in the United States there are only 14 in the Southern States, two in Virginia, two in Tennessee, two in Kentucky, two in Maryland, one in Georgia, three in Alabama and two in Texas. This is an industry that is well worth investigation, with a good possibility of revealing in certain of the Southern States commercial deposits of raw material suitable for the manufacture of cement.

As has been stated above, potash is one of the ingredients of fertilizer that is used in very large quantities in the South. It looks as though the Cottrell system of saving potash as a by-product in cement manufacturing would develop into a commercial success, and its installation at present and future cement plants is worthy of serious consideration.

MINERAL PAINTS.

A great many of the raw materials used in the manufacture of mineral paints are found in the Southern States, such as asbestos, asphalt, barytes, chromite, clay, hematite, limonite, graphite, gypsum, manganese oxide, mica, ocher, pyrite, quicksilver, quartz (silica), slate and talc. At the present time very little of these materials are being manufactured into paints in the South. The raw material is shipped out, manufactured into paint, and this product shipped back into the Southern States. The manufacture of paints in some of our Southern cities, especially those that have water as well as railroad facilities, offers a very favorable commercial opportunity.

With some of these raw materials, such as ocher, there is among its users the opinion that American is not equal to French ocher. This may be true regarding the ocher as it is now put on the market, but it is very probable that the American variety could be made equal to the French if the producers would give more attention to the preparation of the material for market. The tendency has been to purify the material only enough to make it actually marketable, instead of trying to put on the market a product that was equal to the French ocher and which would demand an equal price.

A study of these various raw materials as to their value for use in the manufacture of various paints in the Southern factory is well worth investigation. Many of these which at first might be considered of little or no value will be found upon investigation to be capable of being purified and suitably prepared for use in the manufacture of paints.

There are large deposits of many of these minerals that have never had more than a casual investigation, and this was before railroad facilities had been developed to the extent that they are now in the Southern States. Some of these which a few years ago were many miles from the railroad are now close to railroad transportation,

Pyrite, which is used in the manufacture of sulphuric acid, gives as a residue, after roasting and the sulphur has been driven off, a product that is composed principally of ferric oxide. There are several uses that could be made of this material. If the sulphur has been very thoroughly driven off, it can be used as an iron ore. It is also available as a pigment in the manufacture of red ocher.

CHROMITE.

The chromite deposits of Maryland and Pennsylvania are nearly exhausted, while in North Carolina there are deposits of this mineral which give promise of developing into deposits of considerable quantity and are well worth considerable investigation and development. The utilization of the chromite—first, for the manufacture of chrome salts; second, for the manufacture of chrome steel—suggests two manufacturing enterprises that offer possibilities for the South. For the manufacture of chrome steel we have plenty of water-power for developing electric power, we have satisfactory iron ores, and thus we can easily bring together all the raw products and power necessary to make chrome steel.

Titanium steel is also attracting considerable attention, and we have in Virginia, North Carolina and other Southern States large bodies of titanium oxide which could be used in the manufacture of titanium steel.

The manufacture of titanium steel and chrome steel should be able to be handled in the same plant.

A steel plant for North Carolina has been suggested from time to time, but it has always been considered as an impracticable manufacturing proposition. There is one locality, however, in North Carolina that is worth investigating for a plant of this type, and that is the iron ore region of Lincoln and Catawba counties, which contains magnetite and hematite iron ores in large quantity. Paralleling the iron ore belt is a belt of limestone which would furnish flux for the iron ores. The Carolina, Clinchfield & Ohio Railway, which has been constructed from the coal fields of West Virginia into and across North Carolina, would connect with the Seaboard Air Line at Bostic, which would give good railroad communication for coal.

GOLD AND COPPER ORES.

There are many low-grade gold and copper ores in the Southern Appalachian States that can undoubtedly be operated profitably if sufficient care and thought be given to the method of treatment. Many of the failures in gold and copper mining have been due to lack of thorough investigation of the ores before attempting to reduce them, thus causing the expenditure of vast sums of money for the erection of reduction works which were not capable of treating the ores for which they were built. Inquiries are now being received for large bodies of low-grade ore, either free-milling or sulphuret ore. Several complex ores, composed of mixed sulphides of iron, copper, zinc and lead, occur in North Carolina, which, I believe, can be treated satisfactorily and profitably.

Another source of investigation that should be taken up is the saving of waste products of smelter fumes. Such investigations have been carried on to only a limited extent in the South, but they should be carried on extensively.

Very little has thus far been done in regard to utilizing by-products from coke ovens. Several manufacturing plants should be utilizing these by-products.

NITRATE PLANT.

A chemical manufacturing plant that has been authorized by the Congress of the United States and which should be located in the South is one for the manufacture of nitrates. As this plant is to manufacture a product which is of very great importance in connection with the manufacture of explosives, the Federal Government has made certain conditions relative to its location. It must be at least 125 miles from the seaboard, must have good railroad facilities, and there must be available at the location water-power that can develop at least 100,000 horse-power. Although there are several localities in the South that would perhaps come up to these requirements of the Federal Government, the Southern States should get together and determine which is the best locality and then all pull together for the establishment of the nitrate plant at that locality. In some of the States the water-powers of suitable size have already been or are being developed and utilized for other purposes, and it is doubtful whether the power would be available for the nitrate plant. There is one locality in the South that stands out very prominently as filling all the requirements of the Government, and this is on the Tennessee River, at Muscle Shoals, in Northern Alabama, near the Tennessee line. This is an ideal location, inasmuch as it is to the west of the Appalachian Mountains and therefore well protected from invasion, can be given splendid railroad transportation facilities, can easily develop 100,000 horse-power, and at the present time the power is not being utilized for any purpose. If this is the most favorable locality in the South, then the Southern States should join in a united endeavor to have the nitrate plant located at this point.

DYE PLANTS.

Considering the enormous quantity of dyes that are used in the South, the question of the erection of dye manufacturing plants should be given serious consideration. There are several conditions in the South that make certain localities in this region favorable for the erection of dye manufacturing plants—accessibility of raw material, water-powers, railroad transportation facilities,

proximity to market for the manufactured products; and favorable locations if it becomes necessary to turn the plant into one for the manufacture of explosives.

PAPER MANUFACTURING PLANT.

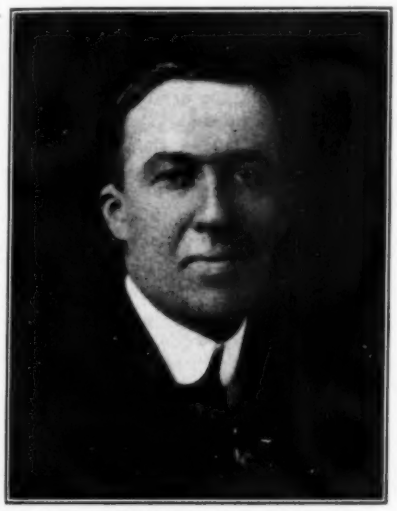
The South is producing a very large quantity of wood for the manufacture of paper pulp, and has at Canton, N. C., one of the largest pulp mills in the country, yet all the raw material is being shipped out and manufactured into paper in some other State. The consideration of the erection of a plant for manufacturing paper in the South is one that is worthy of serious consideration. I believe it is possible to supply such a paper mill indefinitely with an adequate supply of raw material.

Joseph Hyde Pratt.

The Possibilities for the Manufacture of Chemicals of the Alkali and Alkaline Earth Groups in South.

By Richard K. Meade, Consulting Chemical, Mechanical and Industrial Engineer, Baltimore, Md.

THE story is told in connection with the establishment of one of America's great chemical institutions that its founder, on his return from the completion of his chemical studies abroad, wished to remain in his home city. He therefore took stock of its mineral and other resources, and found the former to be salt and limestone, the logical outcome of which was, of course, the establishment of a plant for the manufacture of soda by the Solvay process, since these two minerals comprise the raw materials for such a works.



RICHARD K. MEADE.

His example might be followed to advantage by many young chemists, and in no section of the country would they find more virgin resources than in the South. Not only are the natural resources there, but also in many instances a market supplied from distant points.

The building up of a chemical industry in any section is like the erection of a house—the foundation must come first, then the frame, the roof and the siding, and finally the floors, plaster trim, etc. So it is with the building of a chemical industry. This explains why most chemical works manufacture many different products. Usually between the raw material and the finished product there are many intermediate products, and often these intermediate products are themselves of great use and value in the arts. Nothing illustrates this better than the very much discussed coal-tar dye industry of Germany, which has progressed from the introduction of the retort coke oven and the by-products from this through various intermediates, such as aniline, etc., to the finished dye.

Again, certain chemicals are the basis of practically all other chemicals, most notable of these being sulphuric acid, lime and soda ash. Sulphuric acid may be said to be the basis of chemical industry. It is used in the manufacture of practically all other acids and of many salts. This explains why a sulphuric acid chamber is nearly always a part of a chemical plant. Lime is also used extensively in the manufacture of chemicals, among which may be mentioned Solvay soda-ash, caustic soda, sugar, wood pulp, bichromate of potash, aceate of lime, oxalic acid, etc.

Soda-ash is extensively used in the manufacture of other chemicals, not only per se, but also after conversion into caustic soda by lime. Where large quantities of caustic soda are used the practice is generally to purchase soda-ash and convert this into caustic by boiling with lime.

Nitric acid is, of course, known to be the basis of all explosives, but it is not only made in this country entirely by distilling from nitrate of soda and sulphuric acid, but it is also here used with sulphuric acid. The only source of nitrate, until such time as we develop our own water-power and produce it from air, is Chile. The latter source of supply may, of course, be considered as common to the whole country.

In considering the South, therefore, as a field for the establishment of chemical industries, it is not only advisable to consider the resources as to specific ores, etc., but also as to sulphuric acid, lime, soda-ash, etc., and the raw materials from which these can be made.

It is not the intention of the writer to deal with the sulphuric acid resources of the South, as the occurrence in this section of pyrite and sulphur, the two sources of the field, are well known, and will no doubt be treated of elsewhere in this issue, but in touching on the many chemical resources of the South mention should be made of the by-product sulphuric acid plant of the Tennessee Copper Co. at Ducktown, Tenn. This plant is, I believe, one of the largest sulphuric acid plants in the world, and, making acids as it does from smelter fumes, which would otherwise be lost, can produce acid at a very low cost. The company has a large tonnage of acid to dispose of, and the location of the plant is in a country abounding in mineral resources. It seems likely that this company can dispose of acid at a figure less than the cost of production would be to the small manufacturer, thus making the location of chemical plants in such cities as Knoxville, Chattanooga, Johnson City, Tenn., and Bristol, Va., an attraction.

In the region of this large sulphuric acid plant are numerous natural water-powers, which could be developed and utilized for the manufacture of nitric acid from the air. This combination would make a most attractive one for the manufacture of explosives, coal-tar dyes, celluloid and other chemicals made by nitration with mixed acids.

At Baltimore is located a very large plant for the manufacture of sulphuric acid—that of the Davison Chemical Co. This plant is one of the most modern in existence. Its construction is of the most permanent type, and the facilities for handling the ore are of the best. This plant can turn out a large tonnage of acid at a low cost, and can also deliver concentrated acid. Like most sulphuric acid plants, its output is now said to be sold up, but at the cessation of the European war these people will no doubt have a large quantity of acid for sale—particularly as the production of acid at Baltimore by the fertilizer people has been largely increased.

For those chemical industries which figure on importing a part or all of their raw materials, Baltimore offers every inducement that can be offered by Jersey City and other cities of the northern seaboard, and some additional ones. Unexcelled transportation facilities, both rail and water; cheap acid, coal, labor and electric power, in my judgment, make the Curtis Bay and Canton neighborhoods of Baltimore destined to be one of the greatest chemical centers of the world.

The lime resources of the South are among the most prominent in the country, and while the quantity burned there is not unusually large, the number of good undeveloped limestone deposits is very numerous. Along the various railway lines of the South are located many lime kilns, and there are also some very extensive plants. Both high calcium and magnesian limes are obtainable; the former, however, are usually required by chemical manufacturers, although in certain industries, such as in the manufacture of wood pulp by the sulphite process, the latter is generally employed.

The Valley of Virginia is dotted with lime plants, and the lime from these goes as far north as Jersey City and Niagara Falls. All along the slopes of the Appalachian Mountains are to be found deposits of pure limestone, while further west we have the limestones of the Mississippi Valley, extending from Louisville to south of Birmingham. In fact, all through the great mineral belt of the South limestone can be found near at hand for such industries as burn their own lime, while those who prefer to purchase will find no difficulty in getting a steady supply of pure lime at a low figure.

Both labor and fuel are cheap in this section, and lime can be made at a low cost, provided the equipment of the plant is proper. Low sulphur coal is available where lime low in sulphur is required.

There are a number of large modern lime plants in the South. Besides those mentioned in the Valley of Virginia, there are numerous large plants near Martinsburg and Berkeley, W. Va., and near Frederick, Md. These now supply an extensive trade in chemical lime, which goes to all parts of the East. Farther south we have large plants near Knoxville, Chattanooga and Birmingham, and the writer is building a large plant at Kingsport, Tenn.

By the way, in passing it may be said that this little city, in the speed of its growth a second Hopewell, is becoming quite a chemical center. It is located in a section rich in minerals, with an abundant water supply, very cheap coal and cheap labor. **Electric power is supplied from the new 10,000-kilowatt plant of the Clinchfield Portland Cement Corporation at a much lower figure than can be touched in any Eastern city outside of Niagara Falls. The plant is one of the finest in the world, and is equipped with the most efficient machinery available. Coal is used to generate power, but the cost of fuel here is very low. Already there are located at Kingsport a large cement plant, a dye works, a bark extract plant and a terra-cotta works. A wood pulp mill and a lime and hydrated lime plant are being built.**

Two industries which have, so far as I know, never been established in the South which have limestone for their raw material are the manufacture

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of chalk and of magnesia. The former is made from pure high-calcium limestone, and the latter from dolomite. Both these industries need primarily a pure raw material. Chalk or whiting is made from caustic soda waste, but the latter contains some caustic soda, and it is difficult to free it from this. It has been found profitable, therefore, owing to the freedom of the product from this impurity, to make chalk directly from lime by slaking the lime to a thin milk and then saturating with carbon dioxide. The precipitated carbonate of lime is then collected, washed and dried.

The process is not difficult, and the capital needed to enter the industry not great. Very pure lime is needed, however, and, of course, cheap coal and labor are an advantage. No skilled labor is required, but the process should be under trained supervision. A number of Southern limestone deposits are sufficiently pure to serve as a basis for chalk. Cheap labor, very well suited to such work; cheap coke, free from sulphur, and a good market now supplied from a distance form an inducement for the establishment of a chalk plant in the South.

The manufacture of magnesia and magnesia salts is carried out chiefly by several large concerns located mostly in the East. The process employed where dolomite is used is the Pattinson one. In this process the first step is, of course, to burn the stone to lime. The lime is slaked and the milk of lime so obtained is treated with carbon dioxide under pressure. The magnesium bicarbonate so formed is more soluble under these conditions than the corresponding calcium salt, and hence the magnesium bicarbonate goes into solution, in this way effecting a separation of the two carbonates. The solution containing the magnesia is decanted from the residue of carbonate of lime, and is treated with steam, which decomposes the bicarbonate forming the normal carbonate, which is insoluble, and is thus obtained as a fine precipitate, very white and of loose texture. By calcining it is converted to the oxide.

Besides the manufacture of magnesia and its salts directly, the establishment of a plant in the South would open up the way for the manufacture of many magnesia products, such as pipe coverings, magnesia blocks, etc. The fact that good, pure, high magnesian limestone, cheap coal and labor are to be had in conjunction in many parts of the South makes this an attractive location for those contemplating establishing such a plant. In addition to the manufacturing advantages, the South is a market which is now being supplied from northern points.

While not of either the alkali or alkaline earth groups, another product which is a constituent of limestone, and which was at one time extensively made from limestone, is carbon dioxide. It is so intimately associated with the minerals, however, that it may be considered here. Formerly this was made from limestone, or better dolomite, by acting on the latter with sulphuric acid, the gas being liberated by this treatment. Now the more general process is to make it from coke or from the waste gases of lime kilns. In either event the gases are made to pass upward through a tower, in which they mingle with a descending stream of carbonate of potash solution. This dissolves the carbon dioxide, and the gas is liberated from this solution by boiling, after which it is dried and liquified.

The temperance sentiment which is now sweeping over the South has increased enormously the consumption of "soft" drinks. Since the principal use of carbon dioxide is in the manufacture of beverages of this character, the consumption of the gas in the South is increasing also. The sale of carbon dioxide has one peculiarity. The container in which it is sold represents a greater value to the manufacturer than the gas itself—all shipments being made in heavy steel tubes capable of withstanding great pressure. The tubes not only represent a greater value, but also in a tube full of gas the tube itself weighs more than the gas it contains. Furthermore, the tube must be returned to the manufacturer. Representing as they do a considerable value, the manufacturer is required to invest a larger amount of capital in tubes where they are not returned to him promptly than where they are. These points make it highly desirable that plants be located where the freight charges on tubes can be cut to a minimum, and where the manufacturer can keep track of his tubes. For this reason plants are usually located in a good center of distribution. There are only a few plants located in the South, and much gas is shipped in from the North. This would seem to be an attractive field for the investment of capital in the South.

Nearly all of the proposed methods for the manufacture of potash from feldspar propose to make use of limestone as the principal reagent for attacking this mineral. As is probably known, there are in many sections of the South large dykes of feldspar in close proximity to extensive ledges of pure high calcium limestone, and this condition is much to be desired, as the cost of assembling the raw materials at the plant must be low if the potash is to be extracted at a figure reasonable enough to allow it to compete with the German salt after the war.

The feldspar to be used for the manufacture of potash need not be free from iron, and for this reason many deposits not suited to the pottery trade are available as a source of potash; the only requisite is that the mineral shall be high in this element. It seems probable that of the methods most likely to prove successful in the end for the extraction of potash from feldspar that depending on the ignition of the mineral with lime, either with or without the addition of calcium chloride or other reagents, to a temperature sufficient to volatilize the potash, and catching the potash by means of the Cottrell system, promises most. The residue from this process might also be used for the manufacture of Portland cement.

Of course, these processes are largely in their experimental stage, and much skepticism naturally exists as to the probability of anything coming of them. At the same time, there is no doubt that the problem of producing potash from feldspar commercially by this process, or some modification of it, is considerably simplified by the ability to assemble feldspar and limestone cheaply at one spot. If we can also bring here cheap fuel the process seems still more likely of success. I am informed that there are in Southwestern Virginia and Eastern Kentucky and Tennessee some deposits of feldspar which, although impure from iron oxide, are nevertheless high in potash. This region abounds in limestone, and coal also is cheap here. What better location could be found, therefore, than this for the carrying out on a commercial scale of the process? The eastern feldspar deposits are far from limestone and coal, and offer less chance of success. Most of them, while free from iron, are also low in potash, which, while satisfactory for pottery, is much less desirable for potash extraction than if the potash and iron were both higher. The cost of coal at these deposits is also fully twice that in the localities first mentioned.

Aside from the production of more or less high-grade potash there is a chance to produce by the above process a material suitable for fertilizer, running high in both potash and lime. Such a material would be valuable not only for its potash, but also for its lime. Naturally, the price of this fertilizer to the consumer would be low, and its transportation to a distance would be prohibitive, owing to the cost of freight. The South is a great user of both lime and potash, and such a fertilizer could be sold in the territory in which it was manufactured. In connection with this, it may not be amiss to say that the first attempt to catch and utilize the potash now lost from the cement kiln stacks is being made by a Southern mill. While the production of potash of any degree of strength or purity from such sources presents a very difficult problem, the mill will undoubtedly succeed in saving in the form of a very valuable fertilizer the potash recently wasted there.

The possibility of the potash fertilizer brings us to the point of another lime fertilizer which has received some attention of late, viz., the phosphate of lime fertilizer, made by heating together a mixture of phosphate rock, lime and a small percentage of some reagent, such as soda ash, sodium, sulphate, etc. The compound so formed resembles Thomas slag in chemical composition and properties. The phosphoric acid in this is not water-soluble, but is citrate-soluble, and is hence available for plant food. Thomas slag has been extensively used in Europe for a fertilizer, but in this country the farmers prefer the water-soluble acid phosphate, made by acidifying phosphate rock with sulphuric acid.

The process of making the basic lime phosphate mentioned above is in general as follows: The phosphate rock, soda-ash and limestone are ground together and the resulting fine powder is burned in a rotary cement kiln. The resulting semi-fused clinker is ground, and is then ready for use. Many reagents have been proposed in place of soda ash, and numerous patents have been taken out covering the use of reagents of different sorts and in different proportions. The basic patents, however, upon which all of these processes depend have expired.

Much experimenting upon these processes has been done. The writer has investigated a number of them. The results, generally speaking, are promising, but not yet conclusive as to commercial success, due chiefly to the doubt as to the cost of educating the consumer up to the value of these products as fertilizers. Unfortunately, they cannot be produced under normal conditions much cheaper than can the acid phosphate, due to the low price of sulphuric acid, which can be purchased or made by the average fertilizer factory at from $5 to $5.50 per ton. Nevertheless, there are certain considerations which make the commercial possibilities of the process good. One of these is the fact that the process can be worked to advantage on low-grade phosphate rock which could not be economically treated by acid. These furnace processes of rendering phosphoric acid available would bring into use large deposits of phosphate material now considered of no value because of the fact that the acid process cannot be carried out commercially upon it.

Naturally these phosphate deposits would offer the most promising field of work. The chances for success financially in the development of such deposits along the line of furnace treatment seem good. Naturally the South offers the best field for such an industry, because the phosphate deposits are located there and the great market for phosphate fertilizers is in the South.

Closely akin to calcium is the metal barium. Its compounds are chiefly used in the manufacture of paints, although some use is found for them in other industries, such as in the manufacture of hydrogen peroxide, of green signal lights, in purifying sugar, etc. Prior to the present world war most of the barium ore, and, indeed, more of the barium products, came from abroad. With the beginning of the war and the consequent shutting off of Austria as a source of ore and Germany as a source of barium compounds, those American manufacturers already making barium compounds were forced to seek local ores, while new factories were built to produce the compounds.

The principal localities of barium ore (barytes or barium sulphate) in this country are in eastern Tennessee, southeastern Virginia and northern Georgia. The ore from these localities is now being used by all American manufacturers. So far there are only a few factories located in these districts, the most notable of which are a mill at Sweetwater, Tenn., and a new mill at Johnson City, Tenn.

The principal compounds manufactured are carbonate of barium, sulphate of barium and lithophone, the latter being a mixture of zinc sulphide and barium carbonate.

Barium compounds are produced by heating barytes with coal in a suitable furnace, whereby the barium sulphate of the ore is reduced to barium sulphide. The latter is soluble in water. The furnaced product is therefore leached with water when a solution of barium sulphide is obtained. If barium carbonate is to be obtained, soda ash is added to this solution when carbonate of barium is precipitated. The latter is washed thoroughly by decantation, collected by a filter press and dried. If barium sulphate or blanc fixé is required, sodium sulphate is used instead of soda-ash; otherwise the process is the same.

Lithophone is much used in paints. It is prepared by adding to the barium sulphide solution prepared as above a solution of zinc sulphate. Double sub-

stitution occurs, and the precipitate consists of zinc sulphide and barium sulphate. This precipitate is collected by a filter press, dried and ignited at a low red heat in a muffle furnace. It is quenched by being drawn into water while still hot, ground very fine, collected, dried and again ground, when it is ready for the market.

No section of the country offers better inducements for the establishment of plants for the manufacture of barium compounds than does the section around the border line of Virginia and Tennessee. Not only is the barium ore found here, but coal is very cheap, and coal is a considerable item in the manufacture of these compounds. The labor required is not of a very high grade, except at the furnaces, and even here good, intelligent local help can soon be broken in. This section is also rich in zinc, hence it is also a logical point for the manufacture of lithophone. The markets of every section of the country can be reached conveniently from this source.

For those who fear the end of the war will bring back foreign ores at a figure which will put the American manufacturer who uses native ores at a disadvantage, such ports as Norfolk and Baltimore might offer a compromise point, where either the foreign ore could be imported or the domestic ore brought in by rail. Personally, however, I feel that the native ores will be able to hold their own.

Earlier on in this article I have mentioned the need of soda-ash in many industries. One large soda-ash plant is now located in the South. The production of this chemical is in the hands of a few very large producers, and naturally an outsider will approach the manufacturer of such a commodity with temerity. Nevertheless, it may be permissible in an article such as this to say that for those who are willing to "buck the trust" there are numerous and extensive sources of salt in the South, and conditions here, due to limestone in close proximity to the salt and cheap coal, make for low cost of production. There is also a large local market awaiting the manufacturer.

In conclusion, I might say that many of the industries which I have mentioned may be financed with, comparatively speaking, small capital. At the same time, it is only fair to warn that the chemical industry is a highly specialized one, and success will seldom follow any undertaking in manufacturing chemicals not in experienced hands. Those who enter the industry must be prepared to put up considerable capital beyond that needed to finance the building in order to work out the many difficulties often met with in manufacturing from new and untried raw materials.

To the experienced manufacturer seeking a location for a new factory for any of the chemicals mentioned above the South offers many inducements as a location. Its minerals are in close proximity to cheap coal, and in this same locality are usually to be found fine water-powers awaiting development, and in some cases developed and offering power at a cheap rate.

Richard K. Meade

Southern Iron Ores as a Source of Potash.

By JOHN SHARSHALL GRASTY, Ph.D., Sc.D., Mining Geologist.

THE cutting off of the German potash supply has naturally directed attention in this country toward the possibility of obtaining potash from domestic sources. It has long been known that potash occurs in the gases given off by blast furnaces in the manufacture of pig-iron and from the kilns used in the manufacture of Portland cement, but it is only recently that the possibility of recovering potash from these gases has been seriously considered. The fact that it is possible to recover potash from these sources in commercial quantities seems now to be fully established, and the Security Cement & Lime Co., one of the pioneers in this field, has already erected a "treater" plant especially designed for this purpose. The process employed is in accordance with patents taken out by F. G. Cottrell, the principle being to pass the gases from the kilns through a series of tubes having high electric discharge. The effect of this is to precipitate very completely all particles of solid material carried by the gases, and the gases are thus cleansed and the potash recovered as a valuable by-product.

J. SHARSHALL GRASTY, Ph.D., Sc.D.

There is no reason why the Cottrell process cannot also be applied to the precipitation of dust carried by the gases from blast furnaces. As it has not yet been applied to these operations, there would, of course, be certain problems to be worked out; but it is the opinion of Mr. J. J. Porter of Hagerstown, Md., general manager of the Security Cement & Lime Co., who is also an experienced furnaceman, that it should not be as difficult to recover potash as a by-product from a furnace operation as from the kilns of a cement plant. Furthermore, in addition to the recovery of potash, possibly other valuable minerals such as zinc, etc., contained in the gases in finely divided state would no longer largely go to waste, but thus be saved as paying by-products. The introduction of the Cottrell process to recover potash, zinc, etc., from furnace gases would have the further advantage of giving clean gas for use in stoves and boilers. It is estimated roughly that a "treater" plant suitable for taking care of the gases from a 150-ton furnace would cost approximately $75,000, if no especial effort were made to rush it to completion. If, though, a special effort were made to complete it promptly so as to take advantage of present prices, Mr. Porter, who has assembled a great deal of cost data on the erection of these "treater" plants, is of the opinion that the cost would probably be in the neighborhood of $100,000.

The amount of potash to be recovered at any given furnace operation as a by-product would, of course, depend upon the composition of the raw materials employed. The calcareous raw materials, for instance, made use of in the manufacture of Portland cement by the Security Cement & Lime Co. average about 1 per cent. of potash (K_2O). These beds of limestone, according to analyses reported by Mr. Porter, vary all the way from 0.50 per cent. up to 1.40 per cent., and the potash follows the impurities in the stone quite closely. A high-grade fluxing stone could not be expected, therefore, to carry as much potash as a stone more or less argillaceous in its nature. The more argillaceous or shaly the limestones (and these, by the way, would not be adapted for use as fluxing stone, though suitable for the manufacture of Portland cement), the more potash they would probably be found to carry. This is indicated by analyses on the material used at the plant of the Security Cement & Lime Co., where, for instance, the shale runs over 3 per cent. potash, or is about six times as high in potash as the purer grades of limestone.

Some time ago Mr. Porter stated in a letter to the writer that his company expected, by the use of the Cottrell process, to recover about three tons per day of water-soluble potash (K_2O), which, according to the range in recent prices, is quoted at from $300 to $700 per ton. As the cost of production in this plant will, according to figures submitted to the writer, probably be less than $10 a ton, obviously this by-product will contribute largely to the earnings of the company, and since the same process is well adapted for use in recovering potash from the gases of blast furnaces making pig-iron, it will also in the latter instance be a source of large profit. However, the amount of potash that would be recovered would depend upon the amount of potash carried by the ore, coke and limestone. If ores high in potash be available, obviously the yield will be accordingly larger and the "treater" plant correspondingly more profitable.

It is reported that a number of blast furnaces are selling their flue dust for its potash content without having made any attempt to recover from the furnace gases the maximum amount of potash. In this connection it may be noted that the Security Cement & Lime Co., prior to the installation of its potash recovery plant, sold the dust that collected at the base of the stacks. This dust averaged about 3½ per cent. soluble potash, and was sold to fertilizer manufacturers for $2.50 per unit K_2O. It would seem obvious, therefore, that if the Cottrell process can make a commercial recovery of potash as a by-product in the manufacture of Portland cement, it has great possibilities if employed to recover potash, etc., at blast furnaces. As has been previously stated, however, the commercial possibilities of the recovery of potash both at cement and furnace plants are, of course, absolutely dependent upon the potash content of the raw materials. One of these materials, which, by reason of its potash content suggests itself for use in connection with the manufacture of Portland cement, is orthoclase or potash feldspar, which, when pure, has the following composition:

Silica	64.7 per cent.
Alumina	18.4 per cent.
Potash	16.90 per cent.

Unfortunately, however, the proportion of silica to alumina in this potash-bearing feldspar is such that its use in "the mix" in the manufacture of Portland cement is limited both on this account and by the chemical composition of the limestone and shale employed and their ratios of silica, alumnia and iron. However, there is no doubt that it can be introduced into the regular "mix" to great advantage in certain instances, and thus considerably increase the yield of potash in the "treater" plant, while its silica and alumina would combine with the other necessary ingredients which go to make Portland cement.

In view of what has been accomplished in the matter of recovering potash as a by-product in the manufacture of Portland cement, and the fact that the same process can be applied to the recovery of potash as a by-product in the manufacture of pig-iron, an investigation of the Southern iron ores with respect to their potash content was undertaken at the request of the editor of the Manufacturers Record. All analyses of the Southern iron ores that could

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be obtained, amounting to 1784 in all, were examined by the writer's engineer, Mr. F. B. Speed, Jr., with the following results:

State.	Analyses examined.	Analyses showing determination of potash.
Virginia	95	0
Georgia	151	12
Alabama	649	6
Tennessee	170	0
Mississippi	47	0
North Carolina	397	4
South Carolina	13	0
West Virginia	90	0
Kentucky	172	170
	1,784	192

The iron ores of Kentucky, it will be observed, are the only ones which show the determination of potash to any extent. At the present time these Kentucky ores are of subordinate commercial importance as compared with the ores of Alabama, Virginia, Georgia, Tennessee and North Carolina. It will be noted in referring to the above table that no determinations were made for potash on the Virginia or Tennessee ores. There were, then, but 22 determinations made on the more important Southern iron ores. From the figures given above it is evident, therefore, that little is known about the potash content of many of the more largely worked of these iron-ore occurrences. Probably the district in which potash content in iron ores has been more completely investigated—but even then not as thoroughly as it might be—is the Gray ore district of Talladega county, Alabama. In view of the possibilities offered in the recovery of potash as a by-product in ironmaking, it would certainly seem that a further investigation of the commercially important iron ores elsewhere would be well worth while and should be undertaken at once.

With regard to the presence of potash in iron ores, the observations on this subject made in a report* by Edwin C. Eckel, formerly chief of the Iron Ore Division, United States Geological Survey, are particularly interesting at the present time, when ores containing potash have a special value. It will be observed from the quotation from this report which follows that Mr. Eckel, while not pointing out the possibility of the recovery of potash as a by-product—which, of course, he could not do, as at that time (1907) the process for doing so had not been perfected—calls attention to the metallurgical advantages of its presence. He says:

"Presence of Potash in Gray Ores.—A certain amount of criticism of the gray ore has been based on their assumed potash contents. This criticism may be regarded as due to ignorance on the part of the critics of the facts of the case. The conditions to be considered are as follows:

"(1) The gray ores do not in general show high percentages of potash.

"(2) Potash in small quantities is rather a benefit than a detriment.

"(3) Many well-known American ores carry much more potash than the Talladega ores.

"These conditions may be taken up in turn.

"As to the percentage of potash actually carried by the average gray ore little is known, but it will probably fall under half of 1 per cent. The only recorded analyses in which potash determinations were made are as below:

	Potash and soda.	Locality.
1	1.95 per cent.	Mesaba Mine.
2	1.57 " "	Emauhee Mine.
3	2.11 " "	Emauhee Mine.

"As to the effects of potash in the furnace, it may be said that:

"(1) If present in excess, and not allowed for in proportioning the burden, potash will attack the furnace-lining. This effect would probably not be noticeable unless the potash in the total mixture was over 3 per cent.

"(2) It is a strong fluxing agent, and will neutralize in certain percentages of the silica contained in the ore, acting as well in this respect as considerably larger percentages of limestone. In ordinary quantities, therefore, potash will aid in the slagging of the burden.

"(3) Potash is a very efficient desulphurizer, being better in this respect than either lime or magnesia.

"From the above summaries of the effects of potash in the furnace, it will be seen that it can be regarded as beneficial rather than detrimental when present in such small quantities as in the Talladega gray ores.

"The same conclusion as to the effects of potash could be reached by considering the following table, which gives the potash and soda percentages in a number of well-known American ores. These analyses are quoted from official reports, and the analytical work, done by Blair, Whitfield, Gooch and King, was beyond question.

Alkali Percentages in Some American Ores.

No.	Potash.	Soda.	Total.	Kind of Ore.	Locality.
1	0.70	0.44	1.14	Brown Hematite.	Salisbury, Conn.
2	0.99	0.02	1.01	Specular Hematite.	Quinnisec Mine. Menominee Range, Mich.
3	1.54	0.17	1.71	"	Cornell Mine. Menominee Range, Mich.
4	2.29	0.30	2.59	"	Cornell Mine. Menominee Range, Mich.
5	0.92	0.86	1.78	Magnetite.	Keystone Mine. Marquette Range, Mich.
6	1.47	0.10	1.57	Brown Hematite.	Beattyestown, N. J.
7	1.13	0.34	1.47	"	Amenia, N. Y.
8	1.80	0.17	1.97	Specular Hematite.	Wolf Creek, Tenn.
9	0.99	0.14	1.13	Magnetite.	Riverville, Va.

"All of the above ores are from well-known mines, and all have been largely used and favorably known in our blast-furnace practice. In view of these facts, it seems ridiculous to criticize the Talladega gray hematite in this respect."

A comparison of the potash content of the gray ore of Alabama with other Southern ore occurrences brings out the fact that it appears to lead all others in this respect. However, the data as to potash content in other Southern ore occurrences is so incomplete that at the present time this comparison, which is so advantageous to the gray ore, hardly seems to be justified. The analyses on the ore occurrences quoted by Eckel in the above table, giving the alkali percentages in some American ores, indicate that potash in quantities ranging from .070 to 2.29 are not at all unusual; and hence it may be anticipated that many of the Southern ores will be found to contain around 1 per cent. potash, as is contained, for instance, in the raw material employed by the Security Cement & Lime Co. If, therefore, the "treater" plant of the Security Cement & Lime Co. proves successful, which Mr. J. J. Porter, the manager of the company, anticipates will be the case, then it will be definitely demonstrated that the same process applied to blast furnaces would also pay, and as a result the iron industry of America will make this country more or less industrially independent of Germany, in so far as our supply of potash is concerned. The possibilities involved are enormous and are of such a nature as to justify a full investigation of all materials employed by blast furnaces to determine the question of the possibilities alluded to, which are fraught with such unusually attractive potentialities.

J. Shankland Grasty

*Report to Alabama Ore & Iron Co., December, 1907.

Barium Chemical Industry in the South and Vast Resources of Barytes as a Foundation*.

By JAMES M. HILL of U. S. Geological Survey.

THE Southern States have in their abundant supplies of baryte a raw material for an important chemical industry which, prior to 1914, was practically undeveloped in the United States, but which has within the last year and a half grown at a rate that has been astonishing. This industry, started in the South, was caused by the stoppage of foreign barium chemical supplies on the outbreak of the European war.

The South has vast resources of crude barytes (barium sulphate), which have been developed to some extent and which are the foundation of a chemical industry whose possibilities have just begun to be realized. The South has within its borders, in addition to this basic mineral, all the necessary requirements for the complete development of this industry. It has coal for roasting, natural gas for power, great possibilities of cheap electric power in its many unharnessed streams, and has already in operation a number of plants at which sulphuric acid is made. Wrapped up in the partly developed electric power it has the possibility of the fixation of nitrogen in its various forms, and so is capable of producing nitric acid and various nitrogen compounds. Incidentally, it has possibilities of making the various coal-tar colors which with barium sulphate (blanc fixe) and barium carbonate make any number of paint pigments.

The deposits of crude barytes are located in Northeast Alabama, Northwest Georgia, Eastern Tennessee, Central and Western Kentucky, Western North Carolina and South Carolina, and Western and Central Virginia. With the deposits in Southeastern and Central Missouri, it can be said that within the South are found practically all the deposits of barytes in the United States which have been exploited in the past to any considerable extent.

The greater part of the barytes produced in the Southern States is mined from residual clays which are derived from the weathering of rocks in which the mineral was originally found. By far the largest number of these deposits are located in clays derived from the weathering of old magnesian limestones (dolomite). Some are in clays derived from the breaking down of very old crystalline rocks, like schists and gneisses, and in a few places residual deposits derived from coal-bearing formations have been worked. The barytes in the residual deposits came originally from the hard rocks. Owing to the slight solubility of the barite, quartz and chert, these minerals resisted the agencies of weathering and were left behind with the clay upon the removal of the soluble constituents of the original formations.

The present distribution of workable residual deposits seems to have been determined largely by the distribution of the barytes in the original formations, but, in part, is due to other causes.

Detailed descriptions of the barytes deposits of the Southern States have recently been published.[1]

*Published by permission of the Director of the United States Geological Survey.

JAMES M. HILL was educated Chicago public schools, University School of Cleveland, Ohio, and finished preparatory work at Chicago Manual Training School, graduating in 1902. Attended the University of Chicago, taking B. S. degree, specializing in geology, 1906, and entered service of U. S. Geological Survey, 1907. Since 1912 been specializing in barytes industry of the United States, among other duties assigned in the Survey.

[1]Watson, T. L., and Grasty, J. S. Barite of the Appalachian States. Am. Inst. Min. Eng., Bull. 98, pp. 345-390, February, 1915.
Hill, J. M. Barytes and Strontium in 1915. U. S. Geological Survey, Min. Res. of the United States, 1915, pp. 161-187, 1916.

As will be seen from the following table of production for the last decade, compiled from the United States Geological Survey reports on mineral resources, practically all of the domestic barytes produced in the United States has come from mines located in the South.

Production of Crude Barytes in the Southern States, 1905-1915.

	Quantity, Short tons.	Value.	Proportion of total U. S.
1905	48,235	$148,803	100 per cent.
1906	50,231	160,367	100 " "
1907	89,621	291,777	100 " "
1908	38,527	120,442	100 " "
1909	61,945	209,737	100 " "
1910	42,975	121,746	100 " "
1911	38,445	122,792	100 " "
1912	37,478	153,313	100 " "
1913	45,288	156,275	100 " "
1914	51,547	153,715	100 " "
1915	108,547	381,032	99 " "
Total	612,849	$2,019,999	

The largest output of crude barytes has been from Missouri, which, prior to 1915, produced approximately 60 per cent. of the total, but in 1915 her mines produced but 36 per cent. of the total, practically all of the remainder coming from Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee and Virginia.

Prior to 1914 a large part of the domestic barytes was sold in the ground form to manufacturers of paint, rubber and various other commodities in which barytes plays a more or less important part. Some was used in the manufacture of lithopone, a chemical pigment consisting of approximately 70 per cent. barium sulphate, from 25 to 29 per cent. zinc sulphide and from 1 to 5 per cent. zinc oxide. So far as can be learned, little barytes was made into barium chemicals before the European war, though it cannot be doubted that there was a small domestic production of blanc fixe as a by-product and of various minor products with barium salts as a base. In 1915 figures compiled by the United States Geological Survey indicate that 50 per cent. of the crude barytes marketed in that year were sold in the ground form, 40 per cent. was used in the manufacture of lithopone and 10 per cent. in the manufacture of barium chemicals.

In the barium industry chemistry plays a most important part, for even the preparation of ground barytes requires a knowledge of chemistry for bleaching the crude material. The manufacture of lithopone is essentially a chemical industry, as, of course, is the making of the various barium chemicals. Barytes is ground at a number of plants in the South, and barium chemicals are now being made at three places in the South. So far no lithopone has been made in the Southern States, which seems remarkable inasmuch as every essential for its manufacture is produced in the South and in large amounts. Surely, with the combination of zinc carbonate ores and barytes, such as is found in Eastern Tennessee, it would seem that lithopone should be made in that State. However, it must be remembered that the lithopone plants were built before the European war and were placed on the Atlantic seaboard for the reason that German barytes could be obtained there cheaper than the domestic ore because of high freight rates.

Of the ten barytes grinding and bleaching plants operated in 1915 in the United States, eight are located in the South, of which three are in Missouri and one each in Georgia, North Carolina, South Carolina, Tennessee and Virginia.

The treatment of crude barytes to make ground barytes varies in different plants. The general practice, however, seems to be to crush to about one inch and log wash and jig to remove clay, calcite, fluorite, silica and part of the iron oxide. This cleaned material is next crushed to one-quarter to one-eighth inch at some plants and ground fine in others and subjected to a bleaching process. The bleaching, largely to remove iron oxide, is accomplished by treating the material with sulphuric acid from eight to twenty-four hours in lead-lined wooden tanks. The bleached produce is washed several times and ground in burr mills or pulverizers to pass 200 to 300 mesh, and in some plants water-floated to insure a uniformly fine product, dried, pulverized and packed. Much care is required not only in the bleaching, but also in the drying operation to insure a uniformly perfect color.

Lithopone is made chemically by mixing hot solutions of barium sulphide and zinc sulphate. In the preparation of high-grade lithopone the solutions of barium and zinc must be essentially pure. The precipitate from the tanks is filter-pressed, dried, subjected to considerable heat, quenched in water, ground to pulp, filter-pressed, disintegrated, dried and packed for shipment.

While the South does not produce lithopone, it could do so, and there is a wide field for the manufacturing chemist in the South in this line.

Of the five producing barium chemical companies in the United States three are located in the South—Clinchfield Products Corporation, at Johnson City, Tenn.; the Durex Chemical Co., at Sweetwater, Tenn., and the Rollin Chemical Co., at Charleston, W. Va. It would seem that there is an opening for plants located in Alabama, or possibly Georgia, though the question of markets must be studied prior to such location.

The principal barium chemicals made in the United States are the binoxide, carbonate, chloride, hydroxide, nitrate and sulphate or blanc fixe. Some crude barium sulphide (black ash) is sold. All of the barium compounds are poisonous, and care must be exercised in their manufacture and handling.

As there are no published accounts of the actual methods used in manufacturing barium chemicals, and as it is not ordinarily possible to inspect chemical plants, it is not known what methods are actually used in the preparation of the barium salts at various plants. The manufacturers of barium chemicals, while they prefer to use washed high-grade barytes of the soft variety, nevertheless can, and some do, use barytes which could not be used for the highest grades of ground-floated barytes. The first step in the barium chemical plants is the reduction of the barium sulphate to the sulphide which is soluble in water. The barytes is finely crushed and mixed with a certain proportion of pulverized coal and common salt (an abundance of which are produced in the South) and fed to rotating furnaces, where it is roasted for three to four hours. The charge is next leached. The extraction of barium sulphide is ordinarily stated to be 70 per cent., though it is known that a higher extraction can be made. The liquid from the barium sulphide leach is stored in large heated tanks, from which it is drawn into the different vats for the preparation of the various salts. Barium sulphide can be precipitated by allowing the solution to cool below 150 degrees.

The processes of manufacture of the various chemicals are intricate and require special study and application of chemical and physical knowledge when done on a commercial scale. It is known in general that the carbonate and sulphate can be precipitated from the hot sulphide liquor by the use of appropriate salts of sodium and that a salable sodium sulphide by-product will be formed. It is also known that barium chloride can be made by treatment of the sulphide liquor with hydrochloric acid. Barium nitrate can be made by treating the sulphide solution with nitric acid or by mixing hot, saturated solutions of barium chloride and sodium nitrate. The preparation of the binoxide or peroxide (BaO_2) and hydroxide ($Ba(OH)_2$) are said to require a particularly high degree of technical skill, as very high and low temperatures are required during the course of process and the materials require careful manipulation to insure uniformity. Barium monoxide or baryta (BaO) can be made by heating the nitrate till the evolution of red nitrous oxide fumes ceases. The hydroxide ($Ba(OH)_2$) can be formed by the combination of baryta and water or by passing moist carbon dioxide gas over heated barium sulphide, forming the carbonate, after which superheated steam passed over the carbonate forms barium hydroxide, with the evolution of carbon dioxide.

Unbleached ground barytes is sold to manufacturing chemists, to paint manufacturers for incorporation in colored mixed paints and to the rubber or other industries where a colored product is made. The bleached and floated barytes of the finer grades is used as a white pigment and as a filler for the chemical pigments. In the paper industry it is largely used in the manufacture of heavy, stiff materials such as playing cards, bristol boards and the like.

Lithopone is used as a white pigment in ready-mixed paints, being largely used for the preparation of what are called the sanitary flat-finished wall paints. It is also used in some enamels, calcimines and in the rubber, paper and cloth industries, where it is replacing ground barytes and some of the metallic pigments.

The barium chemicals have a wide variety of uses and may enter into the manufacture of other products, only to return to the market as the sulphate blanc-fixe. Barium binoxide or peroxide (BaO_2) apparently finds it principal market with the manufacturers of hydrogen peroxide, though some is believed to be used in the preparation of oxygen. Barium carbonate is used as a water softener in the preparation of other barium chemicals and rat poison, in the manufacture of flat wall paints and in the ceramic industry. It is said that barium carbonate will fill the requirements of case carbonizing steel which were formerly filled by ground bone. Barium chloride is used in the preparation of other barium salts, as a water softener, a chemical reagent, particularly for the purification of table salt, to some extent in the ceramic arts, and in the preparation of rat poisons. Barium hydroxide is used as a chemical reagent. It can be used in the refining of sugar, but on account of its poisonous nature is not often employed. Barium monoxide has its principal use in the preparation of the binoxide and hydroxide. It is used to some extent in the manufacture of special glasses. Barium nitrate is used as a chemical reagent, in the preparation of "green fire" and signal lights and in the manufacture of an explosive known as saxifragin.

That the South is beginning to realize the importance of the barium chemical industry is apparent. It has already doubled its output of crude barytes, and, to judge by what information is at hand, 1916 will show an even greater output than the remarkable one of 1915. The three barium chemical plants of the South are apparently in strong hands, and they will materially increase the prosperity of the country. There seems to be little question that another year will see the expansion of the manufacturing of barium products, and surely the South, with its great natural resources, will take the lead in this development. The most promising line would seem to be in the establishment of lithopone plants, for in Southwest Virginia and Eastern Tennessee are found all the natural essentials for the successful manufacture of this relatively new and very useful pigment.

J. M. Hall

2,500,000,000 TONS OF IRON ORE.

Because both of their quantity and their geological distribution, the ore reserves of the South seem destined to play a far more important part in the American steel industry than they have in the past. In estimates prepared a few years ago, but which need no material change today, it is figured that merchant ore reserves of the South amount to over 2,500,000,000 tons. This is about half of the total ore credited to the United States. If we attempt to make world comparisons, figured on, as nearly as possible, the same basis, the South's ore reserves would be about twice those of Sweden, three times as large as those of Great Britain, four or five times as large as those of India. Indeed, the only tonnages which are on the same scale as those in the South would be the deposits of our own Lake Superior region, of Newfoundland, of Brazil and of the Lorraine-Luxemburg region.—E. C. Eckel, Economic Geologist and Engineer.

An Opportunity for the South in the Dye Industry.

By P. R. Moses, President of Moses, Pope & Messer, Inc., Consulting Engineers, New York and Richmond.

THE South has had presented to it now an unexampled opportunity for the development of a great industry based on its hitherto unutilized natural resources. Will it grasp it, or will it let the prize go, as so many others have gone, to other sections of the country?

P. R. MOSES.

The prize is the new industry made possible by the great war—that is, the manufacture of dyes and drugs from the by-products obtained in the manufacture of coke and gas and in smelting operations.

The dye industry is essentially one which must be located near the raw materials, because for every pound of finished dye produced from fifteen to twenty pounds of raw material must be used, and a great proportion of this cannot be reused. It follows that for every tenth of a cent added to the freight rate per pound on raw materials from one to two cents a pound is added to the cost of the finished product, and this means from two to three cents a pound added to the selling price.

As the profits under severely competitive conditions on some bulk goods, such as the "blacks," are from one-half cent to one cent per pound, the importance of correct location in respect to source of raw materials cannot be overestimated.

The South, and particularly the mountainous part of the South, offers the best location possible for such an industry, because the raw materials are those derived from the preparation of coal, from iron and copper smelting, from salt, and from limestone and wood. All these basic materials are found in abundance in these sections, and they are not found anywhere else in such close proximity to each other and within such a short distance of the market for the product.

From coal in the process of making coke and gas are obtained ammonia, from which in one process nitric acid is made, benzol, toluol, zylol and solvent naphtha, all of which are crude materials for the manufacture of dyes and drugs.

Other materials are sulphuric acid obtained in the process of purifying copper and iron ores or directly from sulphur; chlorine, caustic soda and soda ash, obtained by passing electricity through ordinary salt brine; lime by the burning of limestone; acetic acid and alcohol from the distillation of wood and other sources. In this connection the great water-power developments and the undeveloped water-powers still to be found all over these regions are of vital importance.

All of these favoring conditions may be found within a radius of one hundred miles in the mountainous districts of Southwestern Virginia, Tennessee, Alabama and Georgia, and all that is needed for the development of this industry are reasonable freight rates on short hauls for low-grade materials and on the finished product, and enough enterprise and capital to start the industry on a sufficiently broad scale so that it may have become strong enough to live and grow after the present abnormal conditions cease.

The process of dye making is not one requiring a great deal of capital in proportion to the value of the product, nor is it one requiring complicated mechanism involving long delay in construction. The process is essentially one of dissolving, cooking and evaporating. For example, to make one of the prominent intermediates known as "beta naphthol," which is largely used in making red color on cotton goods, it is only necessary to take naphthalene (derived from coal tar), mix it with sulphuric acid, add lime and soda, boil it down, dry it, mix it with caustic soda at a high temperature so as to fuse the mass, and then boil it again in order to purify it, after drying. It will be seen from this, and this is a typical process, that most of the apparatus necessary consists of iron tanks, wooden tubs and vessels, which can be made in any good foundry or woodworking establishment, and boilers, engines, pumps and filtering apparatus, which may be purchased in many places.

Skill, of course, is necessary, and the manufacturer of dyes has no more an easy road to travel in this respect than the manufacturer of any other product. He can, however, obtain assistance from the published material on the subject, and the development which has already taken place in the dye industry in this country, together with the help which may be obtained from neutral countries abroad, will suffice to start the industry on a firm footing.

By this we mean that no experimenting is now necessary for the production of a number of products, as the knowledge required for their manufacture is already available here, and these products will be sufficient as a basis for future growth.

How much is needed to start such an industry? The amount of capital should not be less than $300,000, nor should it be more than $1,000,000, unless a complete going organization could be taken over, in which case several times this amount could be profitably expended.

The value of the total annual demand for dyes and kindred products in this country approximates $25,000,000, and the quantities used between 35,000 and 40,000 tons per year.

It is not possible to contemplate completely supplying the country's demand in the immediate future, because some of the dyes are still covered by patents (the majority, however, are not, the patents having expired), and time will be required to build up the necessary manufacturing and selling organizations.

Assuming that the proposed plant would supply one quarter of the total demands, this would be equivalent to a production of 10,000 tons per year. Our experience so far has shown that it costs less than $300 a ton of finished product per year; that is, one plant which produces 1000 tons per year of one of the intermediates cost $150,000, exclusive of land, railroad sidings, water supply, etc. Another plant, which is now producing between six and seven tons of finished product (mixed dyes) per day, or about 2000 tons per year, cost approximately $400,000, exclusive of buildings. Hence, a plant for the production of 10,000 tons per year would cost between $2,500,000 and $3,000,000. In normal times a working capital of $1,000,000 should be sufficient, and the value of the annual output would approach $6,000,000. Under the present extraordinary conditions, allowing for a drop of fifty per cent. from present prices because of increased local production, the working capital should be double this amount, and the annual output would be nearer $15,000,000. At the actual prices existing at the present time for contract goods, the output would bring in over $20,000,000, as the prices average well over $1 a pound.

Such a plant could be completed and a few dyes made within four months from the starting of operations, and should be regularly operating, turning out approximately its full output, within six months.

Construction.—The buildings are of simple construction, usually one story, with platforms around the apparatus, which is superimposed in order to allow for the flow of material from one tank to another without interposition of a pump. The main requirement is that the buildings be fireproof, have ample ventilation and afford sufficient protection against weather.

In general, the plant resembles a cane sugar mill, without, of course, the mills or crushers.

These buildings can be put up more quickly than the apparatus can be obtained, and should not cost over a dollar and a half a square foot. Most of the apparatus can be obtained in from thirty to sixty days, but special equipment, such as is required for evaporation, nitration, sulphonation and chlorination, required special mixtures or iron or other metals for resistance to corrosion, and may require three months for the manufacture, and in a few instances four months.

The American chemical engineers and manufacturers are gradually learning the difficulties involved in the industry, and as many of them have been overcome, a concern starting now will not have to contend with the exasperating and apparently interminable delays which beset the pioneers who started in 1915.

The profits under present conditions are of course abnormal and frequently almost incredible. We have knowledge of plants starting with less than $100,000 where the earnings are at the rate of this amount monthly, and profits at the rate of 150 per cent. per annum are not abnormal.

At the same time, it should be noted that many have fallen by the wayside, due to lack of sufficient funds, experience and patience. In some cases fire and explosion, due to lack of knowledge or careless planning, have been the cause of commercial death, but those companies able and willing to purchase experienced and provided with sufficient working capital to cover unforeseen delays have made huge earnings, and will continue to do so for some time.

No one can predict precisely what will happen after the war ceases, but it is probable that the profits will run as they have in Germany, in well-located and well-designed plants, at about 40 per cent. on the invested capital, while less well-located and inefficient plants will go to the wall.

The opportunity is here. Will the South seize it?

P. R. Moses

P. R. MOSES, born November 10, 1874. Received degree in Electrical Engineering, Columbia University, 1895. Previously studied three years abroad in Berlin, Paris and Florence, Italy. Since 1897 practicing in New York as consulting engineer; 1914, in conjunction with Frederick Pope, started Standard Aniline Products, Inc., among first organized after war to manufacture dyes. Fellow American Institute of Electrical Engineers and member Chemists' Club, New York.

WHAT THE SOUTH SHOULD PRODUCE.

If a dozen good chemists and chemical engineers were turned loose on the possibilities of the South, something would have to come from it. The fact that the Canadian Pacific Railway is employing the A. D. Little Chemical Corporation to study chemical possibilities in Canada might suggest the thought of some such plan for the South, but from the larger American point of view this is merely well-deflected, but not new energy. The South should produce more chemists, electro-chemists and engineers, and should interest them in local problems.—Dr. W. R. Whitney, Research Laboratory, General Electric Co., Schenectady, N. Y.

Dependence of Chemistry on King Cotton.

By H. F. Wilhelm Wehe, Cotton Expert, State Department of Agriculture, Austin, Tex.

Cotton * * *
Cotton is King. Hail the King!

DO we realize the immense power which is standing behind his throne? Do we realize his reign over thousands of enterprises, and that thousands of laboring men and women worship his royal highness—without their knowledge?

H. F. WILHELM WEHE.

The cotton plant is a royal plant. Indeed, it is not only one of the most important agricultural plants, but it is also one of the oldest known to mankind.

The cotton plant does not only clothe the inhabitants of the world, but it also supplies them with other necessities of life.

Cotton clothes, feeds, cures and kills man and beast, according to its uses.

Destroy any other plant on earth and human ingenuity will find a substitute. No other plant in all the vegetable kingdom is as absolute a necessity to the human race as cotton.

Chemistry and Cotton.

Perhaps no other science has done so much to advance human progress and to bring about the present high state of commercial development as has the science of chemistry. The cotton plant and chemistry are today very closely related. The chemists of the world have accomplished wonderful things with the cotton plant, and it is worth while to have some of them recalled to our minds.

The cotton fiber is spinnable, and furnishes us with garments and other necessities of wear. The plant supplies us yearly with approximately 20,000,000 bales of cotton fiber.

The fiber itself consists of more than 83 per cent. of pure cellulose, a substance which is highly appreciated in chemistry.

One of the first developments took place in 1838, when Pelouze discovered the reaction of nitric acid on the cotton fiber. This was developed by Schoenbein in 1846, and it gave to the world our well-known explosive, guncotton, which has found so many developments in our scientific world.

In 1844 John Mercer produced, through chemical reaction, the mercerized cotton, which has found its way into the cotton industry to a large extent.

We also have to recognize what the chemists have done in regard to cotton dyes, which industry takes first place in developing the cotton fiber and its uses.

But let us follow the cotton plant, its by-products and possibilities more systematically.

The cotton is taken from the plant in the fields during the latter part of the year. The cotton in seed is brought to the gin, where fiber and seed are separated. The fiber is baled and shipped to the manufacturers of cotton goods all over the world. The seed is left and turned over to the oil mill.

The oil mill industry has been developed in America since 1826. A man by the name of Benjamin Waring discovered the presence of oil in the cottonseed and produced a very fine oil. His gain was on an average of 1 gallon of oil to 100 pounds of seed, or 20 gallons to the ton. Today we are producing from 36 to 50 gallons of oil, which is valued at from 52 to 54 cents per gallon.

In a modern, up-to-date oil mill the seed is delinted. Taking the Texas seed as a sample, the oil mill on an average cuts from 100 to 150 pounds of lint from a ton of seed. First-class enterprises make several cuts. The first cut of 25 to 30 pounds of lint is spinnable, and brings from 7 to 8 cents per pound in times of peace. The second cut of 150 pounds and more brings from 3 to 4 cents per pound, and is used in the upholstering industries and in manufacturing pure cellulose. The hulls, which is that portion covering the kernels or meat, are used as feeding stuff in mixed feeds for stock; also as chicory in coffee and to adulterate tobacco. The hulls are also used in paper manufacturing and fiber boards.

Cottonseed oil today has found extensive use in our industries. First, and on a large scale, for culinary use as salad oils, butter imitations and compounds, such as the latest development, hydrogen fat, used in Crisco, Crusto, Cream of Cotton, and so forth. Second, for sanctuary and ceremonial purposes in churches to take the place of olive oil. Third, for preserving, for medical uses, for mechanical purposes, and the latest development is paints made from cotton rubber or beta pitch.

The oil or the residue of refining is used to a great extent in the manufacturing of soap, as laundry, toilet, soft soap, castile, soap powder, etc. The residue of extraction, the cottonseed cake, is ground and the meal used for feeding cattle, horses, goats, swine and fowls, etc. A high-grade flour, also made from the seed, is used as human food as a substitute for meats. It contains 64.53 per cent. protein. Bread, cakes and pastry are made from it in a mixture with three-fifths to two-thirds of wheat or other flour. The flour has a high value for medical purposes, and has found uses for treatment of diabetes mellitus, Bright's disease, tuberculosis, anemia, chlorosis, typhoid, etc.

The most valuable uses of cotton by-products are traced back to the linters, the commercial name for the fiber on the seed left after the ginning. Thousands of valuable, and today necessary, products can be traced to linters. Linters are sold today for from 5 to 10 cents per pound. Linters are used in immense quantities in manufacturing guncotton and smokeless powder. This product is the base for the celluloid, non-explosive celluloid, the so-called "cellit." The photo industry uses this product to manufacture photo films, moving picture films, plates and papers. The cellulose from the cotton linters is used to a great extent in the paper-making industry.

Not to forget, pharmacy uses collodion, and this same product is used to manufacture artificial leather and horn of late discovery. And last, though not least, by the Schweitzer solution and others, this product is turned into a material used to an immense extent by the garment manufacturers—artificial silk.

To our recollection, this would cover the uses of cotton, but there is more left from the cotton plant—and that is what is left in the field—the cotton plant itself.

What can be done with the cotton stalks? The leaves are used in pharmacy; also the blossoms. Grabots give an excellent feedstuff; they are also used in manufacturing high-grade paper. The root bark is of very high medicinal value, the extract selling for $4.80 per pound.

Now, the cotton stalk itself. Yearly there are millions of acres planted with cotton, and the stalks are left in the field—turned under the soil or burned. Seventy-five million tons are estimated available per season, as the cotton plant is an annual plant, which would give 24,000,000 tons of paper pulp, or 33⅓ per cent. of the total amount of stalks.

An estimate shows that this country has an annual consumption of lumber used for pulp and paper-making which would cover a clearing of over 800,000 acres of forest area. To realize this immense figure: this timber would cover the area of the State of Rhode Island, which occupies 1250 square miles.

What is being done to develop the industry of making paper pulp from cotton stalks? Credit has to be given to an American inventor and his company for trying to develop this problem, but as to the practical working of their methods nothing is known. The company covers their progress to anyone interested, but from several sources it has been reported that the enterprise met with no success. The writer tried to secure data and samples, but no information was given him.

Now comes news from Europe stating that German science in chemistry has developed this question, and will begin to commercialize this problem, and ten to one they will do so. For years the writer has urged the Southern capitalist to develop this industry, along with other problems concerning cotton, but has found no hearing among them.

In the beginning of 1914 a correspondence was exchanged with German industries that wanted to secure cotton stalks, but later the war prevented their shipment, and recently it was learned that the parties secured some from Turkey.

A good price could be paid for the cotton stalk, so that the farmer could buy more and better fertilizer than they would furnish for half of the amount which he probably would get for his stalks.

The by-products are not to be forgotten, as there is fibrous matter for matting, bagging, etc.; also acetone, wood alcohol, amylacetate, ergot, gum, coloring matter, etc.

Cellulose and Its Products—The residue, wood powder, is used as a base matter of explosives, and the offal makes an excellent fertilizer.

A great point to be considered is the removing of the stalks from the field. The headquarters of Mr. Boll Weevil will be transferred to the factory, where he has to give up his life for the benefit of King Cotton. Then even the last part of the cotton stalk would have gone.

This review of a Southern plant, which is a history to the American people, shows the possibilities and potentialities of the cotton plant. Many other discoveries will be made with the assistance of this royal plant. And the scientific chemist should try to give us more new discoveries—not for the benefit of a few individuals, but for the benefit of the human race, by reducing the cost of living.

Which part of this royal plant and what product should be more developed, and which would be worth while to investigate?

First—The cotton stalks.
Second—The cottonseed oil.
Third—The cottonseed meal and flour.
Fourth—The cottonseed hulls, etc.

Approximately the whole plant—every part of it, from the roots to the fiber—will pay the scientific chemist for the time he puts in on it.

The time will come when the cotton plant will be so utilized throughout the world that it will be raised for the by-product and not for the staple crop.

The above are just a few points, but what may cotton not yet bring to this world? Cotton is the greatest gift of nature. Indeed, cotton is the royal plant of the sun-kissed South.

A hearty suggestion to the scientific chemist: Come back and be loyal to our greatest gift! Come to the Sunny South, the Kingdom of King Cotton!

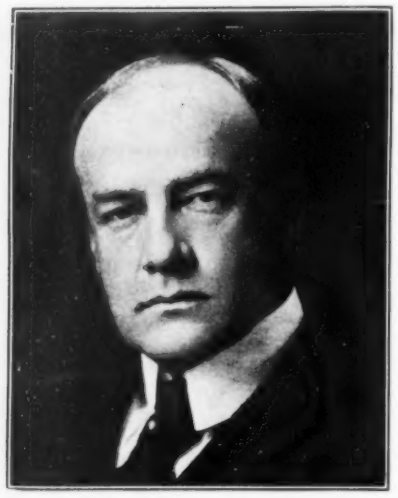
Cotton is king. Hail the King!

The South and the Awakening of Chemical Industry.

The Relation of the South's Resources to National Preparedness.

By ALLERTON S. CUSHMAN, Ph.D., Director Institute of Industrial Research, Washington, D. C.

IT is impossible that a great world war, lasting over a period of years, should not disturb the normal equilibrium of supply and demand, of production and distribution. If the human race could ever be brought to the realization that it consists of a unit made up of some hundreds of millions of puny creatures inhabiting a globe a few thousand miles in diameter rushing through cosmic space to an uncertain but inevitably common destiny, it is possible that war would become as extinct as a dodo or a dinosaur. With such a realization, free and unrestricted trade would become the logical necessity. If, to take a very few instances, glass can best be made in Austria; porcelain, dyestuffs and chemicals in Germany; steel and foodstuffs in America, woolens in England and silks in France, the sensible and logical equilibrium for the race would be to pursue the even tenor of its way, exchanging through the medium of gold these fruits of industry. Unfortunately, however, no such millennium is even in sight, nor can we at present contemplate it as a future possibility. The lesson of the great world struggle seems to be that if a great nation is to preserve its identity and autonomy in face of international jealousy and aggression it must be self-contained in respect to all the staple necessities of life and industry. The question that we are immediately and very briefly considering in this article is to what extent we in the United States are industrially self-contained and the relation of the development of the South to this situation.



ALLERTON S. CUSHMAN, Ph.D.

It is perhaps not too much to say that there are indefinitely limitless possibilities in the application of chemistry to the utilization of the South's resources for the prosperity of the country in time of peace and its defense in time of war. To begin with, the South is and must always be the source and center of cotton production, upon which depends the great chemical processes connected with the cellulose and nitro-cellulose industries. Fertilizers and sulphuric acid, which lie at the very basis of food production and indirectly affect all human effort, are largely produced, consumed and find their raw materials in the South. The great phosphate beds of our Southern States have been in the past, and are destined in the future, to be a center of chemical activity. The outbreak of the European war found every country except Germany dependent upon over-seas supplies of those important elements of nourishment, life and self-defense—fixed nitrogen and potash. Fixed nitrogen, in the form of the nitro-benzenes, is the first and most important element of national defense. In the form of liquid ammonia it is necessary for the cooling and transportation and preservation of the world's supply of meats, poultry products and fruits. In the form of nitrates it is necessary to keep up the fertility of the soil; and in the form of nitric acid it is demanded for the production of many highly colored dyes that serve mainly to beautify and adorn our women, perhaps a not unimportant factor in the evolution of the species. If for all these purposes we are to be dependent upon the nitrate beds of Chile, we are not in this respect a self-contained or a self-sustaining nation. War, blockades or embargo may easily shut off the foreign supply and leave us defenseless and denuded. To whatsoever source or process we turn to relieve ourselves from this intolerable situation, the South is sure to be a factor in it. If we decide, as Germany has done, to depend mainly on the free nitrogen of the air for the source of fixed nitrogen, we must prepare to develop our great water-powers. In this respect, as far as the country east of the Mississippi is concerned, the South is the natural theater of operation. Nearly all of our great waterways run from north to south, and from the best engineering information available the potential water-powers of Alabama, Tennessee and Georgia hold out the best promise of being worthy of exploitation. The nitrogen of the air may be fixed by three separate processes, all of which have been tried out in Europe and successfully operated; but all, either directly or indirectly, depend upon electric power which may be generated either by cheap steam coal or by hydro-electric development. With either or both sources of power the Central South has been richly endowed by the geological and topographical character of the country.

ALLERTON S. CUSHMAN, Chemist, Washington, D. C. Born U. S. Consulate, Rome, Italy, June 2, 1867. B. S., Worcester Polytechnic Institute, 1888; studied Freiberg and Heidelberg, 1889-90; A. M., Harvard, 1896; John Harvard fellow, Ph. D., 1897; associate professor chemistry, Bryn Mawr College, 1900-1; assistant director Office of Public Roads, U. S. Department Agriculture and chemist in charge of investigations, 1902-10; founder and director Institute of Industrial Research, Washington, 1910——; fellow A. A. A. S., Washington Academy Sciences; member American Chemical Society, American Society Testing Materials, American Ceramic Society, Iron and Steel Institute of Great Britain. Principal researches: Extraction of potash from feldspathic rocks; use of ground rock as fertilizers; properties of road materials; cause and prevention of the rusting of iron and steel. Franklin medal, 1906. Author: "The Corrosion and Preservation of Iron and Steel," 1910; also numerous scientific papers and bulletins.

Of the three methods spoken of, the direct, or arc, process for burning the nitrogen of the air with the air's own oxygen is the simplest and most attractive to the mind of a chemical engineer. On the other hand, the process is exclusively a hydro-electric problem and requires no coal and the minimum of raw material, therefore is not likely to interest those who have coal to sell or railroads to carry raw material. In regard to the installation of such direct processes of nitrogen fixation in the United States, a number of good arguments have been urged both for and against. It has been pointed out, for instance, that this process demands extraordinarily large power, and that the cost of water-power development in this country is high, while governmental interference and supervision, both State and Federal, is usually onerous, if not intolerable, to capital. Interest charges on money for hydro-electric development are therefore unduly high in this country as compard with Europe, so that after the war it is possible that we could not compete with Norway and other favored countries in nitrogen fixation. To meet these objections there are those who urge the Government's undertaking the exploitation on the ground of the necessity of the national defense. But this involves putting the Government into business in competition with private enterprise, as any efficient water-power would soon catch up with the demand for nitric acid for war or defense, and would have to depreciate in idleness or go into the production of raw materials for fertilizers. Of course, there is an obvious way out of this difficulty which would involve the Government only in the development of the water-powers and their leasing to corporations under proper but sufficiently generous conditions to tempt capital into the enterprise. But, for reasons that have been suggested above, there are always plenty of influences ready to object to even this indirect entrance of Federal money into the exploitation of developed water-powers.

The cyanamid method of fixing nitrogen is successfully operated for the production of lime nitrogen fertilizer at Niagara Falls on the Canadian side. The process does not require as much electric horse-power per unit of fixed nitrogen as the direct or arc process, but it does require large quantities of coal and limestone. Therefore it bids fair to be the most popular of the proposed methods of nitrogen fixation, and if finally selected, the South is indicated, as it has these materials in great abundance in the neighborhood of its potential water-powers. The difficulty is that the cyanamid process does not directly make nitric acid, which is needed for war munitions. It is true that from cyanamid we can make ammonia and from ammonia nitric acid, but the last step is troublesome and difficult, involving chemical principles which have not yet been successfully worked out except in Germany, and which are bound up with patents and obscure chemical secrets. Nevertheless, what has been already done can be done again, and the probabilities are that we shall eventually see the cyanamid industry established in the South.

The third method of nitrogen fixation which has been successfully worked in Germany is known as the Haber process, in which atmospheric nitrogen, first freed from all traces of oxygen, is mixed with hydrogen and heated at high pressure in great alloy steel bombs, thereby, under the influence of special contact agents known as catalyzers, completing the synthesis of ammonia. It does not seem likely that this process will become a factor in nitrogen fixation in this country under present conditions, but if it should, the necessary supply of hydrogen would probably call for hydro-electric power.

It is well known that in the preparation of coke in the by-product oven very large quantities of ammonia or ammonia salts are saved and used as fertilizer, and possibly, if the difficulties connected with the oxidation of ammonia to nitric acid are overcome, this process can be depended upon to supply the intermediate fixed nitrogen needed for the manufacture of ammunition. It is also well known that the by-product coke ovens save large quantities of benzene and toluene, which are necessary not only for ammunition, but for the manufacture of dyes and a vast number of very important coal-tar products used in modern medicine and photography. The war has already tremendously stimulated the introduction of by-product ovens in the steel and smelting industries of this country, and there are many people who believe that from this one source we can derive all the fixed nitrogen necessary for all national purposes. It is natural that those who have invested large capital in by-product coke ovens, and thereby helped in the conservation of our natural resources in a most praiseworthy manner, do not wish to see their by-product-fixed nitrogen coming into competition with Government-subsidized fixed nitrogen from the air. On the other hand, the farmer wants and needs the cheapest possible fixed nitrogen, and meanwhile the people clamor at the increasing cost of meat and vegetables, the only form in which fixed nitrogen can make any especial appeal to the average citizen. In whatever manner this clashing of interests may work out, the South must take a prominent place, for the iron and copper smelters of Alabama and Tennessee are already factors in the by-product coke recovery processes.

So much for the nitrogen industry. The potash situation is even more uncertain, but no part of the country is more likely to be interested in it than the South. Cotton, tobacco and citrus fruits are all voracious potash feeders, and if the importation of German potash is to be interrupted for two years longer, we must expect to see the results of potash starvation on the staple crops of the South. In the meanwhile the serecite and feldspar deposits of Georgia and adjoining States contain enormous quantities of potash in an

insoluble condition. There are technical processes already worked out by which this insoluble potash could be made soluble, and only the uncertainty as to what may happen when German potash again enters the market has prevented capital from exploiting this field. If the pressure of potash starvation continues, something may yet be done along this line.

The enormous peat-beds of the South also provide a valuable but as yet undeveloped source of fertilizer material. It has been found possible to press most of the water out of the boggy peat and complete the drying in rotary dryers. This material, full of humus and running about 3 per cent. in fixed nitrogen, is an ideal fertilizer filler, although at present cost it cannot compete as a fuel with the cheap steam coals of the South.

The sulphur industry, which is an exclusive asset of the South as far as this country is concerned, lies at the base of enormous chemical industries.

The growing and manufacture of cane sugar is another purely chemical industry in which the South must always be most prominent.

The South is rich in valuable minerals, many deposits of which still remain undeveloped, and even to some extent unexplored. The iron and steel and copper smelting industries of Alabama and Tennessee are large factors in the metal markets of the world and will inevitably grow larger and more important in the future.

The soil and climate of the South permits and invites the development of valuable specialties in agriculture impossible to other sections of our country, and which furnish the raw materials for important chemical industries. Camphor, for instance, which is used for making celluloid and as a medicament and insecticide, is now successfully grown in Florida, along the Gulf Coast, and as far north as Charleston. Specialists of the Department of Agriculture have discovered that instead of being able to take camphor from trees only once in fifty years, as has been the rule, it is possible to produce camphor each year by pruning the leaves from the trees and distilling. There are at present over one thousand acres of trees growing in Florida. Importations of camphor in 1914 were 3,500,000 pounds, valued at $929,000. As a recent bulletin of the United States Department of Agriculture points out, "There are hundreds of other drugs, oils and spices which are imported and which it is possible for this country to produce for itself. In the aggregate the value of these imported articles is rather imposing, as the figures indicate that this country has been bringing in and using about $25,000,000 annually of the various drugs, oils and condiments." Much of this money undoubtedly can be kept at home and represents one of the as yet untried opportunities of the South. It should be remembered, however, that the entrance into these fields is a specialty not to be lightly undertaken by the uninformed, for close preliminary study of the contemplated project is absolutely necessary to success. The Department of Agriculture will always give advice and information in all matters of this kind.

Caffeine is a product which is in great demand in this country. It is used widely as a medicine and as an ingredient in certain popular soft drinks; it is naturally contained in both tea and coffee to the extent of about 3 per cent., and is therefore demonstrably non-poisonous except in cases of over-indulgence, which makes everything poisonous, even water itself. Before the war caffeine, which is made largely from China tea sweepings and damaged cargoes, was selling for about $2.50 a pound. It has recently sold for over $20 a pound. The late Dr. Shepherd successfully introduced tea culture into South Carolina and demonstrated that fine potable teas could be grown, picked by negro labor, cured and profitably marketed in this country. At Dr. Shepherd's death he left to his heirs about one hundred acres of flourishing tea-gardens. It would seem a pity if the work of this enthusiastic pioneer were to be looked upon with indifference by the capitalists and people of the South. If the plantations were extended under proper scientific and business control for the production of potable tea and caffeine as a by-product, it would seem as though there was already a nucleus prepared for the development of an industry which would be especially attractive from the patriotic, as well as the agricultural, point of view.

Castor oil is used in many chemical industries as well as medicinally, and the castor bean can be grown wherever tea will grow and could be cultivated in conjunction with it.

Horse mint, from which the important drug thymol is extracted, grows readily in the South, and only a few days after the imports were interrupted the price of this drug leaped from $2 to $17 a pound. On the other hand, it must be stated that 1000 successful acres of horse mint would probably supply the market, which at present demands not to exceed 17,000 pounds of the drug a year.

Lemon grass, from which lemon grass oil is expressed, an oil which is used widely by soap and perfume manufacturers, can be grown in Florida and probably from two to three thousand acres could thus be profitably employed. As the Department of Agriculture reports show, red pepper, used as a drug and as a condiment, offers a promising field for domestic production in the South. In 1915 in South Carolina 152,000 pounds of this crop were harvested, whereas in 1914 the total imports of this product were nearly nine million pounds. However, as one successful acre should be able to produce about 1300 pounds, we can see that this, like the other specialties referred to, cannot be considered in the light of a staple crop.

Belladonna, digitalis, hydrastis, indian hemp and many other valuable medicinal plants that were in the main imported from Europe before the war are now being grown in Virginia, but these are difficult crops to produce and should not be undertaken by growers who lack the special knowledge and chemical control necessary to their successful culture.

The lumber resources of the South and lumber by-products, such as naval stores, turpentine, etc., are too well known to require special emphasis, but the application of chemistry and chemical engineering to the lumber industry holds out great promise for the future. Already there has been worked out in the South a process for producing pure alcohol from wood sawdust, which may well come to be of great industrial importance in the not far distant future.

It is difficult within the limits of a brief article to cover the whole field of industrial possibility which awaits the application of science to industry in the South. Enough has been said to show the almost limitless possibilities which lie ahead. Already America has learned many valuable lessons as a result of the great European conflict. The South should not and will not allow itself to lag behind in developing the great heritage that has been given it. If its people are alert to their possibilities, and if capital will come out of its hole and be conservatively bold, employing knowledge and science instead of groping futilely in the dark, success and prosperity will come from the rich resources of the South as surely as daylight follows darkness.

Why Men Do Big Things in a Big Way: the South as a Virgin Field for Operation in Industry.

By CHARLES CATLETT, Economic Geologist and Chemist, Staunton, Va.

WE are apt to discuss with enthusiasm the natural resources, or the gifts which nature has so lavishly bestowed on the South, while we are moved to look with distrust and antagonism on the skill, the energy and the capital which alone can make these gifts of nature of any value.

The public not uncommonly begrudges that portion of the returns which goes to the contributors of these latter forces.

It is the bad and envious side of human nature which is thus instinctively distrustful of the rich and the successful, **yet above everything else the South needs the rich and the skillful to make available its natural resources, and it makes a peculiar call upon these men.**

As abounding as may be the opportunities for money-making in the South, I am strongly of the opinion that money-making is the least of the considerations which has and will attract great capitalists and successful business men. If a scheme of development does not make money it shows it was not conceived along right lines or has not been managed efficiently, and no one wants to be associated with a failure and no section is helped by a failure. But when an equal or greater profit can be made in one direction, why does the man of large means, who can choose his path, go in another?

One of the strongest of human motives is the fear of being forgotten and the desire to accomplish something in a material way that will live and grow and be of service to mankind. This is not the less true of the man who may be credited with a course of life which seems to have been dictated by no generous or humanitarian consideration.

The great charm and attraction of the South is that it is still so largely virgin. It is possible for one individual or a small group of individuals to do so much to change conditions over a wide field and to upbuild and to vivify, and the result of any such effort stands out conspicuously. It is this which makes the strongest appeal to the successful business man.

Surely it must have been some such motive which induced Flagler to build his Florida East Coast Railway, where for so many miles the water is a wall on the right hand and on the left; or Rogers to build the wonderful Virginian road, which has in one sense removed mountains; or Duke to harness, develop and distribute the water power of the Carolinas; or a group of capitalists to build the "Clinchfield" road in such a masterly way that it is probably the most economically operated steam road in the world.

These men, with their large grasp of affairs, could not have expected a return as immediate or as large, in a money sense, as they could get in some other direction; but with a broad vision, which looked into the future as far as human eye could see, they must have been allured by the difficulties to be overcome, the great influence which their efforts would have on the course of

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CHARLES CATLETT, Chemist, born at Staunton, Va., August 18, 1865. Hoover Military Academy; University of Virginia, 1884-7; graduate scientific and engineering courses, specializing in chemistry. Assistant chemist U. S. Geological Survey, 1887-9. Started private chemical laboratory in Staunton, 1892. Has devoted attention largely to examination and report on developed and undeveloped mineral properties, mainly in Southern States, for Carnegie Steel Co., United States Steel Corporation, Pittsburgh Steel Co., Allegheny Ore & Iron Co., Southern Steel Co., Southern Railway; A., T. & S. F. Ry.; Carolina, Clinchfield & Ohio Railway; Baltimore Trust Co., Georgia Trust Co., etc. Member American Institute of Mining Engineers. Author of articles in technical journals and in Proceedings American Institute Mining Engineers.

human events and the ultimate success which would come (in their lives or afterwards) and which must imperishably link their names with a great service to humanity.

The South, of all the sections of this country, is still most filled with such opportunities and which appeal alike to the pioneer, the upbuilder and the conservative business man. But the greatest of these opportunities, it appears to me, is that which will come from a realization of the opportunities presented for developing those industries which require for their successful life the use of chemical processes and changes.

In the basal materials the South abounds in many things not found elsewhere. It is but necessary to cite cotton and the cottonseed; the peanut and its great possibilities; the long-leaf pine, with its wonderful distillates and derivatives; the stores of phosphates, and bauxite, and sulphur, to make us realize how dependent other parts of this country and the world are on that section.

The management and owners of the Carolina, Clinchfield and Ohio Railway ("Clinchfield") seem to have shown a peculiar appreciation of this opportunity and the work which has been done and is being done on that line promises to make it unique as one of the centers of chemical industry in the South.

Built as one of the great gateways between the Central West and the Southeast Atlantic States, it is destined to be a most important artery of trade, and because of the service it can render it furnishes a helping hand to the transportation systems with which it connects, to the North on the one hand and to the South on the other. Developing enormous deposits of high-grade coking, steam, gas and domestic coals, it leaps over or pierces through, and in that sense destroys, the barriers which separate the great coal fields from sections of the country which must always need coal for their successful industrial life. It is not strange that the builders of the Clinchfield should have seen a great vision; but it is unique in the extent of the efforts they have made to develop its mineral resources and to encourage chemical industries. Many roads, which have been built in the past to follow the line of the least resistance, are confined throughout their length to a few geological measures, and often those which are least productive of valuable mineral. But the Clinchfield cuts across them all, from the lowest igneous rocks to the top of the coal measures, and is unusual in the variety and extent of the mineral products which are available either directly on the line or in close approximation to it.

Some of the fundamentals which come under this head are an abundance of cheap high-grade metallurgical fuel; a furnace producing one of the highest grade pig-irons to be found in this country; limestones, both dolomitic and high calcium, suitable for metallurgical and chemical purposes; a large lime plant for burning lime and producing hydrate; a Portland cement plant; one of the largest and most comprehensive dye plants and chemical plants in the country, which is under continuous construction and expansion, but which has for many months been manufacturing and shipping dyes; a chlorine and caustic soda plant; tannic acid plants; tanneries; pulp and paper mill in the course of construction; a brick plant; tile plant, and a pottery plant. The last is the largest and practically the only high-grade pottery plant in the South. A large chemical plant for the manufacture of acids and zinc and barium compounds, and which will ultimately produce potash by the Hart process, is in active operation. A plan is under consideration for saving the potash from cement kilns. Phosphate rock is a short distance from the line, and the question of the combination of potash and phosphate in the manufacture of mixed fertilizers is under consideration, as is the question of the formation of nitrogen compounds from the air. A wood-alcohol plant is also under consideration, as well as a sulphite paper-pulp plant. Some zinc ore is found on the line, and zinc ore is largely produced a few miles off the line. Clays and feldspars and a great variety of minor minerals are available, and the line is most favorably located for bringing in, on a cheap rate, the sulphuric acid of the Tennessee Copper Co. Interests on the line control by option, and will probably develop, deposits of rock salt which are known to exist a short distance from the road. Within a few miles of the line deposits of bauxite and bauxite clays are found. The water-powers on the line have all been carefully surveyed and catalogued, and generous and sympathetic interest is shown in any move which promises further extension of the chemical and industrial activity.

It is not too much to believe that the careful and far-seeing plans and the sympathetic attention of those who have been responsible for the construction of the road, and who have already done so much along these lines, will result in the Clinchfield road being a great center of chemical industry, with all which that implies. Without such plans and active effort development would be exceedingly slow.

Charles Catlett

Electrochemical and Electrometallurgical Outlook in the South.

By H. D. RUHM, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

SOUTH of the Ohio River and east of the Mississippi lies the most undeveloped territory in the United States.

With a climate and soil so peculiarly adapted to general agriculture that with intensive cultivation it might feed all the States, it has a large part of its own consumption of meats, hay, oats, wheat and corn shipped to it from other States.

H. D. RUHM.

With a large part of the country's remaining supply of hardwood timber within its borders, it buys its wagons, farm implements and other necessities, manufactured from such timber, from the treeless States of the North and West.

Itself the largest consumer of complete commercial fertilizers, possessed of almost limitless stores of three of the great essential elements of such fertilizers, and with enormous power to produce the fourth from the atmosphere, it purchases much of its ultimate supply from factories that take those raw materials many miles and ship back the finished product in increased weight, with added freight both from rate and tonnage.

With unlimited stores of limestone, iron and coal in close proximity, it buys from other sections most of its manufactured steel products.

H. D. RUHM, born Nashville, Tenn., June 6, 1871, graduated Nashville Public Schools, 1887; B. E. Vanderbilt University, 1892. Railroad engineering and sewer construction to 1895; phosphate rock and fertilizer until 1909; when went to Germany and arranged to develop caustic potash manufacture in the United States; built Niagara Alkali Co.'s plant at Niagara Falls, N. Y., occupying position of President, Vice-President and General Manager, at same time retaining connection with large phosphate rock interests as President of Ruhm Phosphate Mining Co. January, 1916, sold contract which had become too profitable on account of the war for company to be willing to carry out. Since then in charge Chemical Department of the Marden, Orth & Hastings Co., Inc., and still President of the Ruhm Phosphate Mining Co.

Its ores of copper, zinc, aluminum and magnesium, and its salt deposits, oil and sulphur, are for the most part still waiting the capital, the energy and the chemical skill to bring them all to that state of high development which is the only requisite to make of this the supply-house, as it is indeed the storehouse, of the nation.

With such a bountiful array as all the above implies, the inviting field open to electrochemical and electrometallurgical engineers is at once apparent. When we appreciate the fact that the territory under consideration offers almost boundless opportunity for the development of hydroelectric power, that master key which unlocks from nature's storehouse the finished products at once so essential to the peaceful growth of a people's commerce and so necessary in that dread time when grim war threatens the nation's life, it is little to be wondered at that the eyes of the electrochemical and electrometallurgical world are turning more and more to bright, beautiful, sunshiny Dixie Land.

Where cotton has so long reigned as king the very near future holds out the inviting prospect of a true "democracy of industries," in which the former king will continue to play an even more important role as one of the fundamental parts of the new republic. Cotton, not dethroned in an invidious sense, but instead of going not only to other sections of this country, but to the rest of the world with the greatest part of his riches, will be made to work at home to the upbuilding of all other branches of manufacturing and to the consequent enrichment of his own fair land.

In all this vast work of recovering and upbuilding, electrochemistry and electrometallurgy must play the most important part, as it is by reason of the enormous progress in these two lines, made possible by the modern development and application of cheap hydroelectric power, that the vast network of industries above hinted at is brought to realization.

Following the line of least resistance, the master minds of these branches of industrial genius have perforce made their beginnings where Norway's glaciers and Niagara's mighty torrent most easily led to the necessary investment of capital to set the electric generators whirring, with little regard to the raw materials which must be transported from a distance.

With the pioneer work of experiment so magnificently developed into definite and readily operated processes, the electrochemical and electrometallurgical people will find in the development of the South along these lines the hydroelectric power scattered over the country in varying sized units from a few thousand horse-power up to the mighty power at Muscle Shoals, on the Tennessee River, a fitting centerpiece, aggregating more electric energy

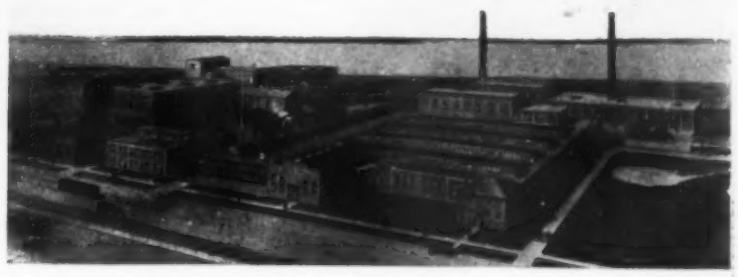
than any similar scope of the country, and all literally surrounded by inexhaustible stores of every raw material for all their operations.

Limestone unsurpassed for fluxing and for all the manifold chemical uses which lime enters so widely, is in the greatest abundance.

Magnesian Dolomite, from which the electric furnace will soon unloose the great future rival of aluminum, is the country rock of much of this section.

TYPICAL OF WHAT HYDRO-ELECTRICAL POWER MEANS IN INDUSTRIAL GROWTH.

NIAGARA ALKALI CO.'S SHOP IN 1909.



NIAGARA ALKALI CO.'S PLANT IN 1915.

Bauxite, from which aluminum is extracted, here finds its greatest profusion. Pyrites and sulphur for the production of the all-essential sulphuric acid are plentiful.

Iron and coal of the best grades lie in countless thousands of tons in deposits that have hardly yet been scratched, ready for the final perfecting of electric furnaces that will make the time-honored blast furnaces things of the past, giving to industry far better and far cheaper iron and steel, with all their multitude of alloys so necessary for modern practice.

From this coal will be produced benzol and toluol, and for the nitrification of these products, both for dyes in time of peace and for explosives in time of war, and also for producing nitrates (the third and most important element of fertilizers), the location of the government nitrate plant in the South, and properly at the great power possibility of Muscle Shoals, Ala., will place this institution where it can aid, and in turn be aided by the profusion of allied products hinted at above.

Phosphate rock, the basis of all fertilizers, here first mined in the United States, still exists in tonnages only approximated in the Far West, where many years must yet elapse before markets near enough at hand to overcome heavy freights by rail will lead to its considerable development, while this favored section uses enormous quantities at home, and still the demand must grow as more and more the effort is made to "grow two blades of grass where but one grew before."

The electric furnace will reduce this material to the essential element, so that high-grade materials may be cheaply shipped to still greater distances or at home make possible the use of higher grades of fertilizers by rejecting the inert materials.

The same agency will make the supply of the ever-increasing demand for ferro-phosphorous an easy and economical matter, when the raw material at the electric furnace door does away with the present high cost of transportation, which has so far practically confined its manufacture to the local blast furnace.

The best deposits of potash feldspar yet discovered lie in this favored region, and with the development of the electric furnace process for extracting this potash by treating the feldspar with common salt and phosphate rock, muriate of potash will be produced so cheaply that Germany's long-time monopoly of the world's business in potash salts will be permanently overthrown.

Common salt, long produced at extreme corners of this section, needs only the proper search and exploitation to develop in many parts of the South producing wells and mines. With this material electrolysis will furnish the chlorine, so essential for water purification, for the bleaching of the textiles produced at home in such ever-increasing amount, as well as for the development of both dyes and explosives from the coal-tar by-products, benzol and toluol.

The by-product of this electrolysis, caustic soda, will produce from the same coal tar products the phenol, the wide necessity of which in dyes, explosives and in industries generally is only recently being appreciated in this country, and at the same time produce our soaps, be used in the textile industry and form the basis of real American production of oxalic acid. Its counterpart, caustic potash will be produced to yet better advantage than ever before from the cheap potash salts referred to and its use in this country will still further extend and widen as it has done in Germany.

Chlorates of potash and soda, bichromates, carbonates, prussiates and cyanides of the same will form an inviting field with raw materials and power so closely associated.

With the bewildering array of materials produced from coal tar and chlorine products and alkali by sulphonation and nitrification, many volumes might deal and still leave the most important parts unsaid.

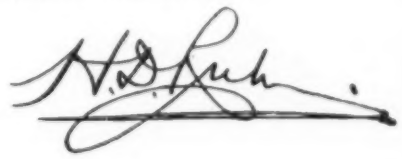
To give anything like a technically authoritative discussion of this subject is not only beyond my power, but would merely weary with its prosiac detail.

Suffice it to say that with the proper progress of the development of hydro-electric power along the lines already started in the South, and with the establishment of the government nitrate plant in that section to serve as a nucleus, the activities of the electrometallurgists and of the electrochemists will have opportunity for successful achievement, such as the past has not held forth.

These activities, showing in the shape of substantial industries in all of the above lines, radiating like spokes of a wheel from the hub of central power production along the beautiful Tennessee River, present a picture of future possibilities attractive and desirable not only to those engaged in such work, but to all patriotic citizens, who believe to the fullest that in time of peace we should prepare for war.

It is a strange commentary on our conservatism that 90 per cent. of all our industries important to us in war should be located within easy grasp of attacking forces.

The great central Tennessee Basin, so well named the "Dimple of the Universe," equipped as above faintly portrayed, offers within the Southern confines that "citadel of the nation," where the arts of war and peace can grow side by side, always fostering the latter to the fullest possible growth, to the mental, moral and physical uplifting of man to really be his brother's keeper; yet at the same time constantly conserving through the former, in a place remote and safe from foreign foe, those essentials for maintaining on a modern scale the defense of all the nation and individual hold dear.



The South and Preparedness.

F. B. CARPENTER, Associate Member Naval Consulting Board and Director for State of Virginia, Organization for Industrial Preparedness.

THE members of the five national societies of chemists and engineers have about completed a great industrial inventory of the resources of this country which would be available to the Government in case of war.

This inventory is showing that the South has made rapid strides in her industrial pursuits in the past few years and that the vast natural resources are not surpassed in any section in this country. We have here not only inexhaustible supplies of coal, iron, sulphur, oil and other materials for furnishing munitions of war, but, what is more essential, with our favorable climate, fertile soil, fertilizer supplies, etc., sufficient foodstuffs and cotton can be grown to feed and clothe a tremendous army.

The South can contribute more to promote National Preparedness, from an industrial standpoint, than any other part of the United States, and the development of her resources means not only greater prosperity in the Southern States, but will be of inestimable value in the defensive preparations of our nation.

The great European struggle has taught us that we must change our past conceptions of war, and, instead of putting our main dependence on men and guns, organized industry is the bedrock upon which we must build our defensive structure. We are not looking for war, but we are learning from the experiences of other nations that if we are to remain a world power we must prepare to defend our rights.

For the future welfare of our nation, therefore, every encouragement should be given to the development of these vast natural resources, whether it be from National or State governments or private enterprises.

THE LAND OF OPPORTUNITY.

I have endeavored to outline, as I see them, the chemical potentialities of the South, and in particular to keep away from over enthusiasm. This is hard to do for one who knows the South as a land of opportunity and has seen the sources of wealth which lie on every side awaiting scientific development. Great things are in the air, and the chemist, too, is called on for great things. The South asks him to make bricks and iron and food and clothing for the whole country and to make them better and cheaper than they have ever been made before.—Dr. Charles E. Coates, Professor of Chemistry, University of Louisiana, Baton Rouge, La.

Relation of Industrial Chemistry to the Cotton Industry of the South.

By FREDERIC DANNERTH, Ph.D., Consulting Chemist, Newark, N. J.

IT may be said in general that the problems which confront any undertaking are commensurate with the greatness of the project. It is specifically true of the industry which undertakes to supply us with ten or fifteen million bales of raw cotton per annum. In the year 1914 our total national production reached the unprecedented figure of 16,135,000 bales and in 1915 the crop was reduced to approximately 11,161,000 bales, harvested from 31,535,000 acres. No one was able to prophecy the advent of the European war, and the result was that one of our most promising cotton years yielded us a surplus of almost 10,000,000 bales of fiber.

FREDERIC DANNERTH, Ph.D.

Before the arrival of the Mexican cotton boll weevil it was possible to produce as much as 500 pounds of cotton per acre, yet the official government report for 1915 indicated an average yield of not more than 173 pounds per acre, with 315 pounds as the highest yield per acre in any one State within the past ten years. This was obtained in North Carolina in 1911. To summarize the situation it may be said then that the total American cotton crop is influenced principally by the following factors: (1) The condition of the soil; (2) the use of the proper fertilizers in adequate amount; (3) the relative amount of rain and sunshine during the ripening period; (4) the temperature; (5) the presence of insect pests. We might continue to enumerate many more, but these are some of the most signifcant elements. If the crop ripens too rapidly it may be difficult to gather it in before the approach of rain storms and in that case there will be produced a large quantity of stained cotton. This latter product causes considerable difficulty when an attempt is made to bleach it a pure white. The problems then, which confront the planter of cotton are:

(1) What fertilizers can be used in place of potash and under what conditions must these be applied to the soil in order to insure the growing of a healthy prolific cotton plant?

(2) What is the action of various fertilizers on the yield of cotton and the quality of the fiber produced?

(3) What precautionary measures can be taken to prevent the production of stained cotton during seasons of excessive rain?

(4) How can stained cotton be bleached a pure white?

(5) Is it possible to devise a chemical treatment which will destroy the Mexican boll weevil or render it harmless?

It has often been stated that our southern planters have been devoting too much land to the planting of cotton, but it would probably be more correct to say that we have not given enough attention to the growing of high-grade cottons. By this I mean, long staple cottons which would be of value in the manufacture of automobile tire fabrics. In the year 1915 our net raw cotton imports totalled 364,000 bales, nearly all of which was long staple material. Right at this point we have before us one definite opportunity to exhibit our skill in supplying our own textile mills with a domestic product which can be successfully used in place of the imported fiber. Although we produce 62.3 per cent. of the world's cotton, we have within the United States only 22 per cent. of the world's spindles. (Census of 1914 conditions in.) Since the appearance of the pink boll worm, the importation of Egyptian cotton has been fraught with great danger. In order to prevent the introduction of this pest, the United States Department of Agriculture, together with the large importing interests, have been put to a tremendous expense for installing disinfecting apparatus at our ports.

If we stop to consider that we have in Arizona and Southern California a climate perfectly adapted for growing long staple cottons, it at once becomes apparent that we are neglecting one of our greatest opportunities. It may safely be stated that the production of strong, long staple cotton within the United States, on a large scale, offers an immense field for investigation, as the demand for cotton yarns of exceptional strength is increasing rapidly each year. The importance of the problem can be estimated when it is said that they are used principally in the production of fabrics for automobile tires.

SIDE PRODUCTS OF THE COTTON GROWING INDUSTRY.

Turning to the industries which have developed as a result of our extensive cotton culture, we find that—cotton seeds when pressed yield cotton seed oil and cotton meal; the oil when chemically treated yields glycerin and solid fats used for cooking; the stalks have yielded a fiber which is well adapted for making paper; the linters have proven a valuable raw material for the manufacture of imitation silk and horsehair; the fiber itself has been used for a long period for the manufacture of guncotton, plastic cellulose acetates, lacquers, photographic films and artificial leather.

AT THE FACTORY END.

The most important use to which any product of the cotton plant has been put is undoubtedly the manufacture of cotton yarns and fabrics in the textile industry. In certain cases they are used in their natural condition without any chemical treatment whatsoever, but in most cases the yarns used for underwear, hosiery, sweaters and gloves, dress goods and printed goods, book cloths and decorative fabrics are bleached, dyed or printed before they are finally marketed. This involves the application of at least three distinct chemical processes. An examination of the census for 1915 shows that of the three leading southern textile states, South Carolina, with 180 textile plants, possesses one plant devoted exclusively to the chemical processes; Georgia, with 190 plants, contains five such works, and North Carolina, with approximately 440 textile mills, has within its borders four plants devoted to bleaching, dyeing, printing and finishing.

Experts in textile factory management are of the opinion that the principal chemical processes cannot be conducted efficiently by a mill unless the volume of goods to be treated reaches a minimum of 5000 pounds per day. This is more especially true of the processes of dyeing and bleaching where exceptional skill is requisite. In this connection it is interesting to note conditions in the Philadelphia district. Here we find that of the successful concerns which dye and bleach there are at least ten plants which handle 10,000 pounds or over per day, while ten others handle over 5000 pounds of material per day. In the case of print works it would seem that a minimum production of 25,000 yards per day is required for efficient management. As an example of a plant which successfully handles an exceptionally large volume of work in bleaching and printing piece goods we have the Pontiac Bleachery in Rhode Island, which handles 50,000 pounds per day.

LABORATORY MANAGEMENT.

Industrial chemists of today recognize three principal departments of work in the control of factories where chemical processes are used: The purchasing department, served by the buyer's chemist; the manufacturing department, served by the factory chemist, and the selling department, served by the sales chemist.

For the purchasing department, he prepares specifications for the purchase of chemicals, oils, soaps, dyes, finishing materials and raw cotton. After the shipment has arrived at the mill it is examined to determine if it meets the standard set by the specifications. If so, it is accepted as a good delivery. This work includes the microscopic identification of raw cotton, measuring the length of staple and determining the resistance of the fiber to bleaching.

For the manufacturing department, the chemist examines the processes at present in use to determine if there is an opportunity for simplifying the operations or preventing unnecessary waste. He makes suitable recommendations for adjusting such processes as are not conducted in accordance with the best known practice. If any process is causing defects in the finished product an invsetigation is made to determine the cause and thus eliminate the item of "spoiled goods." Much of the new work carried out in developing chemical processes has remained unpublished and is therefore known to only a limited group of textile mills. This is due in part to the fact that competition is feared, but it should be strongly emphasized that mills which receive the benefit of accumulated experience cannot but profit by such co-operative supervision.

For the selling department, the chemist examines the products of competing firms so that it becomes possible to reproduce the best effects obtainable in any particular field. This has been criticised as one of the most dangerous elements of industrial chemistry, and yet it must be remembered that this very policy has in Europe resulted in the production of the very highest grade of products at a minimum cost of production. Spurred on by healthy competition, the quality of merchandise cannot possibly sink to low levels.

One of the most unpleasant problems which confront any sales department is the matter of claims for damaged or spoiled goods. For this reason it has now become customary in carefully managed plants to subject all products to a rigid laboratory inspection before shipment. This includes besides the chemical examination a series of carefully devised physical tests to determine the strength of yarns and fabrics and the resistance of dyed fabrics to sunlight and laundering. Imperfections in fabrics may be due either to mechanical or to chemical deficiencies. If due to the latter, it may be safely said that they can be remedied, provided the management of the mill is willing to re-invest a part of the profits. This is in effect nothing else than life insurance for the corporation, for the prosperity of any textile mill is dependent principally upon the quality of the product which it sells.

This then is the question which must be decided before any attempt is made to install chemical control in our American cotton mills. It has become the practice in some cases to charge up chemical control to "expense," but the more conservative mill managers now regard it as an investment which should yield interest and return within a stated time. We, as Americans, will

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soon have to realize that there are many large problems before our industrials and that these cannot always be solved in a week or a year. It is this fact more than any other which must be impressed on the minds of our investors. The remarkable "sunfast" and "laundry-proof" dyes produced in Europe were not perfected in a month or a year, for the patent records of the past thirty years bear abundant evidence of the persistence with which these problems are attacked by foreign chemists and financed by foreign industrials.

This is probably the point which will decide whether or not dyes will be produced in the United States in competition with European factories. The mere investment of capital is not sufficient to the attainment of the end. If lasting results are to be secured it will in fact be necessary to modify the instruction in our American colleges so as to include carefully planned research work in the field of industrial organic chemistry.

The three accessory divisions which co-operate with the department heads in an industrial corporation are those devoted to engineering, chemistry, legal and official chemistry, and research chemistry.

The engineering chemist investigates proposed installations of textile-chemical machinery and prepares lay-outs for such projects as purification of water for use in boiling off and bleaching; treatment of waste waters to prevent stream pollution; recovery of caustic soda from waste mercerizing liquors; production of bleach liquor by electrolysis of table salt; extraction of dye from logwood chips directly at the dye-works.

The division for legal and official chemistry records the latest developments found in patent literature, so that infringement of existing patents may be obviated. If there is a dispute concerning the identity of imported merchandise; if there is a dispute concerning the origin of a fire or the storage of dangerous chemicals in the plant; if there is a claim for spoiled goods which cannot be adjusted in a friendly manner; if the State Board of Health has objected to the pollution of a stream by factory waste waters; if a workman claims to have been injured by chemical fumes or solutions, or if freight has been damaged by contact with chemical fumes or solutions while in transit, all these problems are presented to the division for legal and official chemistry for an opinion and recommendations. In this way it is possible for those who transact business with the United States Customs House, the Patent Office, the National Board of Fire Underwriters, the State Board of Health, or the Civil Courts of the State to secure authoritative advice from qualified sources.

It would seem that the time is ripe for the creation of a well organized development organization which would be in a position to give to the growers of cotton in the South and to the manufacturers of cotton goods in our country conclusive experimental evidence which could serve as a basis for the rational development of both phases of the industry. Many of the engineering problems have already been satisfactorily solved, so that it remains for the industrial chemist and the cotton industrial to become more closely associated. Such co-operative work must eventually redound to the benefit of all concerned.

Frederic Dannerth

Petroleum and Natural Gas in the South as Chemical Resources.*

By JOHN D. NORTHROP, United States Geological Survey.

ALTHOUGH the petroleum industry has long been recognized as an important factor in the industrial development of the South, it is rarely associated in the public mind with the so-called chemical industries. The fact that the petroleum products with which the general public is most familiar are available from the grocery, the hardware store and the filling station rather than the pharmacy has tended to obscure the fact that these products are no less the result of chemical reactions than salt, sulphur, borax, potash and many other products that are popularly accredited to the chemical industries.

JOHN D. NORTHROP.

To be sure, the public is not to be blamed for its attitude of mind on this subject, for probably less is known, even among chemists themselves, concerning the reactions that result in petroleum formation or that take place in the process of petroleum refining than those involved in any other industry of corresponding magnitude.

From a chemical standpoint the petroleum industry furnishes more promising lines of research than any other great industrial enterprise in this country. Though the industry here celebrates its fifty-seventh birthday this fall, and though the value of its raw material now exceeds $200,000,000 in normal years, chemical knowledge of crude petroleum is still in a rather primitive state. Efforts of petroleum chemists have hitherto been directed more to improving the quality of the refined products in greatest demand at the moment than to determining the true nature of petroleum itself or the latent possibilities of the less salable elements, too often sacrificed as fuel or utterly wasted.

This condition has been due largely to the enormous success of the petroleum industry from its inception. The demand for one or another of its principal products has always kept a little ahead of the supply, and the refiners, in their efforts to satisfy established markets, have had little incentive to divert the energies of their chemists to more altruistic fields, where immediate profits were less obvious.

Although typical of the American attitude toward the development of the vast treasures of mineral wealth in the United States, the influence of this practice in the petroleum industry has been especially regrettable, since the supply of crude material on which it is based is by no means inexhaustible.

With the very steady decline in petroleum output in the Appalachian and Lima-Indiana fields, and the westward migration of the center of oil production from Pittsburgh to Tulsa, there has come a decided awakening to the fact that petroleum supplies, once thought ample for the needs of the country for a hundred years, have been practically exhausted within a single generation. This awakening has resulted in a tardy appeal to the chemical engineer to devise new and less wasteful methods of refining and new products that will constitute a more profitable and higher form of petroleum utilization than has been realized in the past.

The response of the chemist has been as gratifying as it has been prompt, and in his response lies a source of enormous power to the States of the South in which the petroleum industry has not yet reached its zenith.

It may be conservatively stated that within the last decade chemical research has added more to the refiner's conception of petroleum and to his ability to control the products of distillation than in the entire period that preceded it.

Today refiners all over the country are eagerly seeking to develop on a commercial scale a variety of new refining processes that in laboratory practice have proved highly efficient in increasing the output of motor fuels, the type of product in greatest demand at the present time.

With but one or two exceptions, the score or more of processes under development involve the principle of "cracking" or decomposition of natural crudes or high-boiling point fractions of refinable crudes, such as kerosene and lubricating oils, by heat and pressure and the alteration of the heavier molecules involved into lighter molecules of the type that compose gasoline and naphtha.

Of these cracking processes the most successful thus far developed, and the only one in fact that is widely employed in the industry, is the Burton process. This process was patented in 1913, and is owned by the Standard Oil Co. of Indiana. It is extensively used in the refineries of that company and of the Standard Oil Co. of Louisiana in the treatment of fuel oils and residuums resulting from the ordinary fractional distillation of Kansas, Oklahoma and Northwest Louisiana crudes. The effect of this process on the resources of paraffin-base petroleum in the South is to increase their value at least one-third, because by its use products of high commercial value are now derived from materials that heretofore could be disposed of at barely the cost of production.

With regard to the low-gravity asphalt-base petroleum, available in such abundance from the salt-dome pools in Southern Texas and Louisiana, chemical research involving principles other than thermal decomposition has already resulted in one process, as yet unperfected on a commercial scale, which offers promise of increasing their yield of gasoline from a negligible 3 per cent. by ordinary methods to as high as 24 per cent., mainly at the expense of the low-valued gas oil fraction. This process, known as the McAfee process, from the chemist who devised it, is being developed by the Gulf Refining Co. at its Port Arthur (Tex.) refinery. It consists essentially of boiling the oil remaining in the still, after the small proportion of gasoline and kerosene normally present has been removed by ordinary methods, with anhydrous ammonium chloride, which effects a catalytic alteration of a portion of the high-boiling hydro-carbons to a mixture of low-boiling hydro-carbons, from which water-white sweet-smelling gasoline, solvent oil and kerosene are read-

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ily separable by fractionation methods. The successful adaptation of this process to large scale operations will increase immensely the value of a type of oil which hitherto has been considered of little use except for fuel and lubricants. The production of this type of oil in Coastal Texas and Louisiana alone amounted to more than 20,000,000 barrels in 1915.

Reverting to the cracking processes, there remains to be considered one of more than ordinary promise which in laboratory practice has shown points of superiority over even the successful Burton process. This is the Rittman process, conceived by a research chemist in the employ of the United States Bureau of Mines and announced by the Secretary of the Interior in 1915. Although the use of this process increases the gasoline yield of any type of crude petroleum—whether of paraffin, asphalt or mixed base—it is said, to "200 per cent. or more compared with old methods," the most novel and distinguishing feature involved lies in its ability to effect the formation from petroleum of commercially recoverable percentages of benzene, toluene, xylene, anthracene and naphthalene. The importance of this phase of the Rittman process is not appreciated until the fact is recognized that the products mentioned comprise the basic materials used in the manufacture of dyes and of high explosives, for which this country has been so long dependent on the coal-tar industry in Germany.

Unlike the Burton process, which is carried out on the oil itself in stills that differ little in appearance from those in ordinary use, the Rittman process is carried out on the vapor of the oil in vertical metal tubes. For the production of benzene, toluene and other aromatic hydro-carbons experiments have shown that the tubes may be of any size from 1½ inches by 3 feet to 8 inches by 14 feet, given a proper adjustment of temperature, pressure and rate of feed.

In brief, the process, which is carried on at high temperature and under constant pressure throughout the entire system, consists in forcing the oil to be treated in at the top of the tube, where it is instantaneously converted to vapor and is drawn downward by the force of gravity into the zone of higher temperature in which the cracking or breaking up of the heavy hydrocarbon molecules takes place. The condensible gases pass thence to a cooler, where condensation is effected When the process is conductd for the formation of benzene, toluene, etc., the resulting liquid is a mixture of these hydrocarbons from which the product desired must be separated by further treatment. When conducted for gasoline formation, which involves conditions of lower temperature and pressure, the resulting liquid consists of a mixture of low-boiling hydro-carbons from which the gasoline is recoverable by fractionation.

In other words, the result of "Rittmanizing" crude petroleum or petroleum distillates is a new type of crude, a synthetic crude, which must be redistilled by ordinary methods, but in which the molecules originally present have been broken down and rearranged under the control of the operator in such a way as to form immensely greater percentages of the particular product desired. An additional feature of great importance lies in the fact that after the desired product is removed by fractionation the residual oil may again be subjected to the process and its molecules rearranged to form still more of the product desired.

Conditions brought about by the European war and by the inability of the available by-product plants of the coke and water-gas industries to supply the needs of domestic manufacturers of explosives in the early part of 1915 resulted in prompt action looking to the development of the benzene-toluene phase of this process to the point of commercial efficiency. Toluene, which on nitration yields the powerful explosive trinitrotoluene, was selling in this country for 25 cents a gallon before the war, but so great was the subsequent demand that offers of $5 a gallon in the latter part of 1915 are reported to have been declined because of a lack of supply. Benzene, known to the trade as benzol, which forms the basis for a great number of explosive compounds and artificial dyes, increased proportionately in value as the stocks accumulated before the war became depleted.

During the summer of 1915 an experimental plant for the recovery of benzene, toluene, etc., by the Rittman process was installed at the Pittsburgh works of the Aetna Explosives Co. In less than six months' time the process was developed to such a point that its successful operation on a commercial scale was assured. Whether it can be operated profitably when prices of benzol regain their normal levels remains to be seen, though this consideration is wholly immaterial beside the demonstrated fact that the petroleum resources of this country are abundantly able to furnish the materials of primary value in its defense.

Although any discovery that contributes to the preparedness of the United States against war has an especial appeal at this time, the fact that benzene and its homologues are important and vital contributors to the arts of peace should not be forgotten. The derivatives of benzene, toluene and xylene, which comprise on the one hand our most violent explosives, furnish on the other hand coloring materials without number which are of greatest importance to the textile industry, and in addition a variety of pharmaceutical products and exquisite perfumes. As a motor fuel benzene has already proved itself an able competitor of gasoline.

To the States of the South the significant progress made in recent months in the efficient utilization of petroleum is fraught with greater possibilities than to any other section of comparable area in the United States.

The center of the petroleum industry is now in the South, and here, it is believed, it must remain for at least another generation. Developments within the last three years in Oklahoma, Louisiana and Texas have revolutionized previous conceptions of the petroleum reserves in those States, and within the past few months developments in Kansas and Kentucky have proved no less significant. Even Tennessee has heeded the summons of the wildcatter with a response that is encouraging if not enthusiastic, whereas Alabama, Arkansas, Mississippi and Missouri include untested areas of much promise. In West Virginia alone of all the Southern States may oil production be reasonably conceived to have passed its crest, but with its long-lived wells, its undrilled locations and its undeveloped acreage of promise this State may easily duplicate the yield of 270,000,000 barrels it already has to its credit before its productive sands become exhausted. With regard to Kentucky, Tennessee and Alabama, oil development is as yet so restricted and geologic evidence so meager that a quantitative estimate of their possible future yield is impracticable.

As to the potentialities of the other oil-producing States of the South, no better measure exists than the estimate furnished last February by the Secretary of the Interior to Congress in response to Senate resolution No. 40 asking for certain information as to the production, consumption and price of gasoline. This estimate, which has behind it the knowledge and experience of about 30 petroleum geologists of the United States Geological Survey, than whom no more conservative group of specialists can be found anywhere, affords ample support to the belief that petroleum development in the South, if not in its infancy, has not passed the stage of adolescence.

The following table, compiled from Senate document No. 310, shows for the States outside the Appalachian province what the South has already accomplished in the way of petroleum production and what applied science is willing to concede as to its future possibilities:

Field.	Production to 1915, inc. Barrels.	Possible future production. Barrels.
Oklahoma-Kansas	617,000,000	1,874,000,000
North Texas	44,000,000	484,000,000
Northwest Louisiana	58,000,000	424,000,000
Gulf Coast	236,000,000	1,500,000,000
Total	955,000,000	3,982,000,000

In other words, it is conservatively estimated by scientific methods that the petroleum resources of the Southwest, not the entire South, are only 24 per cent. exhausted.

Considering the advances already made in the art of extracting from petroleum the products of greatest immediate service to man and converting them from one to another according to the varying demand, it is obvious that the intrinsic value of the 76 per cent. of this resource remaining in the ground is greater by far than three times the value of the 24 per cent. already recovered. As far as the general public is concerned, the effect of chemistry's recent contributions to the petroleum industry is equivalent to a quantitative increase of 50 to 100 per cent. in the oil resources of the entire country. From the standpoint of their potentialities for service to mankind the petroleum resources of the Southwest may be considered, then, as only 12 to 18 per cent. exhausted.

When one realizes that the scientific study of petroleum utilization has scarcely begun, and at the same time considers the enormous capacity of the South for future petroleum production, he may well be pardoned if his vocabulary fails of adequate words to express the limitless scope of his convictions as to the part petroleum is destined to take in the industrial development of the South and the enrichment of its inhabitants.

The position of the South with regard to natural gas resources is no less dominant than with regard to petroleum. The close association of these two hydro-carbons in practically every known oil field warrants the conclusion that large volumes of natural gas will be obtained in the development of the vast oil reserves described in the foregoing section. The fact that natural gas often occurs in large quantities independently of petroleum, as in Western Arkansas, Southeastern Oklahoma and parts of Kansas, favors an even greater future for this industry in the South and Southwest than might otherwise be forecasted.

The statistical records of the Geological Survey bear eloquent testimony to the growing importance of the gas resources of this region. In 1906, the first year for which quantitative evidence is available, the gas fields of the Southern States produced 49 per cent. of the natural gas utilized commercially in the United States. Four years later this contribution had increased to 60 per cent., and in 1914, the latest year for which complete statistics have been published, it was nearly 65 per cent.

West Virginia, the birthplace of the industry in this country, has long maintained first rank among the gas-producing States, and seems to be in no immediate danger of having to yield its place, unless it be to a Southern sister. Its stores of this precious fuel cannot be estimated, but are believed on geologic evidence to be equal to all legitimate demands that may be made on them in the next quarter century at least.

Kentucky, Tennessee and Alabama have furnished as yet little evidence of their capacity for gas production, and their future is largely a matter of conjecture.

In the States west of the Mississippi the natural gas industry may be confidently asserted to be in its infancy, despite the fact that its annual consumption of raw material now exceeds four hundred billion cubic feet and its annual losses are estimated in billions of cubic feet.

Oklahoma and Kansas have been large producers of natural gas for many years, but the sources of gas supply thus far developed cover only a small portion of the vast area in which geologists are convinced that gas is present. Texas and Louisiana, though abundantly favored with natural gas resources, have scarcely begun to develop them on a commercial scale. The magnitude and violence of the gas flows encountered in the Coastal Plain region, of which the Caddo field, Louisiana and the Corpus Christi district, Texas, have afforded several examples, still constitute the greatest physical problem of natural gas development in these States. Recent discoveries in Western Arkansas have ably demonstrated that the gas resources of that State are more than equal to present market demands, and competent geologists have

pointed out untested areas of infinitely greater acreage than the fields thus far developed, in which structural conditions are highly favorable to gas accumulation.

The Coastal Plain area in Southern Arkansas, Eastern Louisiana, Mississippi and Southern Alabama is essentially untested, but its possibilities as a future source of gas cannot be ignored.

Favored as it is with such vast areas of prospective gas territory, is it probable that the South will permit the same rapid dissipation of this priceless resource that has brought the gas fields of the North and Middle West to a state of premature senility? Thanks to the chemical engineer and his brother the mechanical engineer, a negative answer to this question is possible.

The recent contribution by the latter of a method of drilling by which prolific gas sands, penetrated in the quest of oil at lower depths, can be effectually sealed with liquid mud to prevent the escape of the gas, has already resulted in the saving for future needs of billions of cubic feet of oil-field gas, too dry for gasoline manufacture, that was formerly discharged into the open air. Gas that is not intimately associated with oil is generally barren of gasoline, and if developed at all it is by some gas company whose own self-interest prompts it to employ the most efficient methods of conservation.

It is the so-called "wet" gas, produced from oil wells, that contains gasoline, and the processes devised by the chemical engineer for extracting this marketable product form the basis for an industry that is destined to endure as long as the oil industry itself and to attain its greatest development in the South.

That the South is fully awake to the possibilities of this new industry is apparent from the fact that Oklahoma leads the country in the production of gasoline from natural gas, and that West Virginia, until 1914 in first place, is a close second. An idea of the growth of this industry in the South and Southwest is contained in the statistics collected by the Geological Survey, which show that in the period from 1911 to 1914, inclusive, casing-head gasoline plants increased from 80 to 183, daily output of raw gasoline from 22,000 gallons to 110,000 gallons, and gas treated from a scant 1,500,000,000 to 9,000,000,000 cubic feet.

When it is considered that the total quantity of natural gas commercially produced in the South in 1914 amounted to some 381,000,000,000 cubic feet, of which it may be conservatively estimated that one-fourth contained gasoline recoverable either by compression or absorption methods, a faint conception of the potentialities of this infant industry is possible. The use of the term "faint" is justified by the fact that the statistics of commercial production fail to include the annual losses of casing-head gas, running into the billions of cubic feet, that will in the future be largely prevented.

A significant outgrowth of the casing-head gasoline industry that gives promise of increasing still further the value of the latent gas resources of the South is the manufacture of liquid natural gas, which has recently been proved commercially feasible at an experimental plant in West Virginia. This product, which comprises, ethane, propane and the heavier constituents of natural gas, possesses advantages over its parent substance that greatly enlarge the scope of natural gas application and render its benefits available to homes and industries remote from the productive fields. Being free from methane, its thermal value is from 50 to 150 per cent. greater than natural gas and appreciably greater than acetylene, a condition which renders it applicable as a fuel in cutting and welding operations. Its condensed form, its ready portability in steel bottles, its simplicity of application and its relatively low cost of manufacture bespeak for it a marvelous future as a source of light and heat for railway cars and for country and suburban dwellings.

A fascinating problem for the chemical engineer lies in devising a field of commercial application for the methane that forms 60 to 75 per cent. of the volume of the gas utilized in this process, which is now wasted.

Thus far nothing has been said of the part natural gas is competent to play in its premier role—that of fuel. Its ability to supply the magic forces of heat and light so essential to every industry is too well known to require comment. The question of vital importance in this connection, that of supply, has already been answered. Natural gas is indeed at hand in abundance, ready to do its "bit" in the building of an industrial empire in the greater South.

John D. Northrop

The South's Coal and Iron and Their Relation to World Affairs.

By Edwin C. Eckel, Geologist and Engineer.

WRITING in 1913, before even the prospect of a great European war had given point to the statement, I had occasion to summarize the industrial effects of war in the following words:

EDWIN C. ECKEL.

> The economic disadvantages of war are, in the long run, unmistakable, even to the dullest of observers; but temporarily and locally these evils may be so masked by momentary trade activity as to be estimated too lightly. The economic losses are due to the destruction of life and property, to the removal of a large number of men from productive labor, and to the general disorganization of trade and finance. Nothing can make up for these losses; but, as has been noted, they are often temporarily masked by immediate small gains. In nations like England and the United States, which are always unprepared for war, its outbreak causes a feverish activity in many trades. It is necessary to accumulate suddenly supplies of all sorts, and this process normally causes trade activity and rising prices. During such a period of forced activity the demand for commodities is abnormal both in its amount and in its direction. Further than that, it is a demand for tonnage rather than for quality; and for immediate delivery rather than for economic manufacture. So that at the end of a national struggle we normally find all the great industries in an unsound condition and technically less efficient than at the outbreak of the war.

Looking back, after two years of the greatest war of history, I see no occasion to modify these words; and I think that my readers will agree that the summary was a fair prevision of what actually took place. Some, it is true, may question the accuracy of the last sentence of the summary; but even on that point it will be best to await the end of the war before deciding. My own opinion is still unchanged. It is that the large, intense and highly specialized trade activity of the past two years has resulted in a condition of relative inefficiency, both technically and economically; and that the very profits of the immediate past and the present are laying the foundation for a period of very hard times throughout the world.

With this in mind I think it will be of advantage for us to consider now not what industries and localities are benefiting most by the present period of mad prosperity, but what industries and localities will make the best showing when the demands of war have subsided and a relatively brief reconstruction boom has ended.

For the sake of greater definiteness in the study we must introduce certain limiting conditions, and this in turn involves making some rough forecast of future world conditions. We may therefore assume that within two years or so the Old World will have come to peace, but not to a final peace born of complete victory. It will more probably be an uneasy truce, under the name of peace, in reality devoted to the unmaking and remaking of alliances. And for our own national safety it will be best to assume that, just as the hatreds and friendships of the belligerent nations cool, so will our own relations to these former belligerents be subject to change; and that as the necessities for securing American food and munitions and money disappear, there may come about conditions which today it would seem grotesque even to suggest as possibilities. What we have to consider, then, is not the status of certain industries and regions under existing conditions, but their probable future status, facing the certainty of bitter international competition, the probability of further wars, and the possibility that these wars may involve the United States in unexpected ways and against unexpected enemies. The United States has managed to remain nominally neutral at least throughout the progress of a world conflict; it has become prosperous by so doing; but if reports are to be believed, it has also become thoroughly detested by both sets of belligerents. The best we can expect after the close of the war is that foreign competition will be keen, that it will be carefully organized by the various foreign Governments, and that freight subsidies and preferential tariffs will figure to an extent heretofore not dreamed of. If we are to meet these conditions successfully it is evident that there must be equally careful study and organization on our own part.

With regard to the part which the South may fairly expect to play in this future struggle for trade it is sufficient here to summarize briefly the main facts concerning her supply of the basal raw materials—coal and iron ore.

Southern Coal Resources.

In the very detailed report on the coal resources of the world, published in 1913 by the International Geologic Congress, the section dealing with the coal reserves of this country was prepared by Dr. Marius Campbell of the

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United States Geological Survey. Though there have been later changes in the official estimates, most of these changes relate to the coal reserves of the Western States, and are of no importance for our present purposes.

The 1913 estimate gives for the States east of the Missouri River a total coal reserve of almost exactly one million million tons. In making up this total only really good coals are included, no allowance being made for lignites and the sub-bituminous coals.

Of this enormous total just about half is contained within the Southern States. Among these States the principal tonnages are contributed by the following States, the totals being given in round figures:

West Virginia	138,500,000,000
Kentucky	111,900,000,000
Missouri	76,200,000,000
Alabama	61,000,000,000
Oklahoma	49,900,000,000
Tennessee	23,300,000,000
Virginia	19,500,000,000

As a basis for comparison it might be noted that Pennsylvania is credited in the same report as containing about 121,000,000,000 of tons, including both anthracite and bituminous.

The Southern States taken together are credited with containing close to 500,000,000,000 tons of serviceable coal. At the present rate of mining and consumption the Southern coal reserve would last for several thousand years, so that it is difficult to become alarmed over any impending or prospective future scarcity of coal in the south. Indeed, our real problem is not how to save the coal, but how to mine it and get it into use at a faster rate.

Aside from the question of actual tonnage, there is the far more important question as to how these reserve tonnages compare with those supposed to be held by nations which have been our industrial competitors in the past. From this point of view it is of interest to note that the Southern States plus Pennsylvania and Ohio contain more coal than the whole of Europe; that West Virginia alone contains almost as much coal as Great Britain; that Alabama outranks Russia, while Oklahoma has greater coal reserves than Austria. France would fall in order somewhat below the relatively small reserve of Virginia. Germany alone among the European countries is well supplied with coal, the total German reserve being about eighty per cent. that of the Southern States. But as a matter of fact, there is no possible comparison as to the accessibility and extraction cost of German and Southern coals, for the bulk of the German reserve tonnage is at far greater depths than the average American coal.

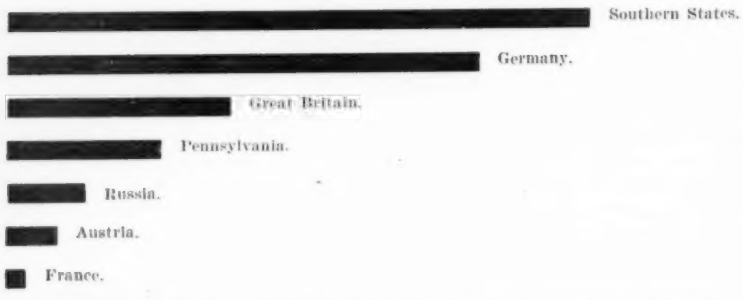

FIG. 1. COMPARISON OF COAL RESERVES OF THE SOUTHERN STATES WITH THOSE OF OTHER NATIONS AND STATES.

These comparative figures will also serve to throw some light on the vexed question of the foreign and import trade of this country after the European war has come to an end. It should be possible to discard any prepossessions in favor of one or the other of these European nations and to consider the matter purely as plain, un-hyphenated Americans. From this standpoint we can see that Austria, France and Italy have no possible chance of becoming our competitors in the manufacture and export of iron and steel or of other heavy manufactured staples. Russia, active propaganda to the contrary, is not likely to become a great manufacturing country. England, owing to increasing coal and labor costs, has been losing ground for some time, and has been a competitor of ours solely because of her freight advantages. Germany has had the advantage of large coal reserves and of fair ore supplies, but these, without carefully organized Government aid, would probably have availed little. If labor costs in Europe rise after the war, as may fairly be expected, we need look for little possibility of competition from even Germany and England, **except in so far as such competition is aided by direct Government action, by cheaper freights, and by preferential tariffs.** Our immediate difficulty is more likely to arise from the competition of Canada than from that of Europe, and even this should normally affect only certain seaboard markets.

But the exceptions above noted must be borne in mind. We will not fail because of lack or cost of raw material or through manufacturing disadvantages, but we may be very heavily handicapped by shipping difficulties and by the differences in foreign and American Government policies. These, however, are matters which do not require discussion here.

Southern Iron Ore Reserves.

Because both of their quantity and their geographic distribution the iron ore reserves of the South seem destined to play a far more important part in the future of the American steel industry than they have done in the past.

In estimates prepared a few years ago, but which need no material change today, it is figured that the total merchantable ore reserves of the South amount to over 2,500,000,000 tons. This is about half of the total ore credited to the entire United States. If we attempt to make world comparisons, figured on as nearly as possible the same basis, the Southern ore reserves would be about twice those of Sweden, three times as large as those of Great Britain, four or five times as large as those of Russia. Indeed, the only tonnages which are on the same scale as those in the South would be the deposits of our own Lake Superior region, of Newfoundland, of Brazil, and of the Lorraine-Luxembourg region.

Of the total Southern tonnage about half is credited to Alabama, a quarter to Texas, and the remainder chiefly to Tennessee, Georgia and Virginia. As to types of ore available it may be said that though magnetites and hard hematites occur in the South, the main reserve tonnages are of two other types, the Clinton red or fossil hematites and the brown ores. Both of these are quite widely distributed throughout the Southern States, and many of the deposits are well located so far as fuel supplies and markets are concerned.

The red hematites are by far the most important of the Southern ores from any possible commercial standpoint. They occur as distinct stratified beds, just as regular as coal seams, in the Clinton formation of Silurian age; and throughout a large area in the Southeastern United States one or more workable ore beds of this type will be found wherever rocks of this age are exposed. The red hematites are known locally as red ores, fossil ores or oolitic ores, according to their most prominent characteristic in the given locality. The red ore beds extend almost without interruption in a southwestern direction from Virginia to Central Alabama. The beds outcrop along the eastern edge of the Cumberland Plateau, and are therefore almost always within easy distance of workable coal beds. It is this close relation of ore deposits and fuel supply which gives the South its great advantage over most other iron-producing regions.

The red ores are developed in greatest thickness in the Birmingham region of Northern Alabama, but are commercially workable in other parts of Alabama, as well as throughout most of Northwest Georgia, Eastern Tennessee, and at a few points in Virginia. At and near the surface the action of surface waters has leached out most of the lime carbonate which the red ores originally contained. The ore near the outcrop are therefore usually low in lime and relatively rich in iron, ranging often as high as 50 to 60 per cent. metallic iron. But this is purely a surficial phenomenon, and when the beds are followed underground to a point where leaching has not occurred, the ore is found to carry considerable lime carbonate and to range from 30 to 40 per cent. in metallic iron.

The brown hematites, or brown ores as they are more simply called, are hydrated iron oxides, carrying even when pure from 10 to 15 per cent. of combined water. A brown ore running 55 per cent. metallic iron would therefore be usually a much purer material than a hard hematite or magnetic carrying the same iron percentage. The brown ores, however, occur usually in very irregular deposits, and almost inevitably require concentration to bring them up to their normal commercial grade of 40 to 50 per cent. metallic iron. Much better concentrating work would be easily possible, but is not at present justified by the ordinary price of Southern pig-iron. As to geographic distribution, brown ores are of so wide occurrence that at first sight it may seem impossible to group the deposits in any comprehensive way. But after longer acquaintance with the subject it will be found that by far the bulk of our present brown-ore output, as well as most of that which will be utilized in the near future, comes from one of three large areas. These important brown-ore districts are respectively:

1. In the Appalachian Valley and its foothills, extending from the northern line of Virginia to Central Alabama.
2. In Northwestern Alabama, Middle Tennessee and Western Kentucky, along the Tennessee River drainage area.
3. In Northeastern Texas.

In all of these districts brown-ore deposits of large size occur, and the total tonnages available are very large, ranging in the hundreds of millions of tons. The districts differ among themselves in the character and associations of their ores and in their present degree of development, and can therefore be discussed separately with more clearness than if we attempted to consider all the Southern brown ores at once.

Finally, it is necessary to mention the occurrence of deposits of magnetite and specular hematite long the Blue Ridge and related areas in Central Virginia, the western portion of the Carolinas and Central Georgia and Alabama. Most of these deposits are badly located so far as fuel and transportation are concerned, so that they have not been seriously developed except at a few points. But their concentrating possibilities are such that they offer much hope for the near future.

* * * * *

From this necessarily brief description of the coal and iron ore resources of the South it will be seen that they are ample in quality and well distributed for commercial utilization.

The extent to which such utilization will be carried in the near future, and the importance which the Southern supplies attain in foreign trade, will depend very largely, however, upon factors which cannot be determined so readily. Among these are the relations of the United States to the other great Powers, the commercial policies which will be adopted by the European nations after the war, and the manner in which these foreign policies are met by our own Government. None of these are things which can be definitely known in advance, but some of them are within our own power to determine. It is to be hoped that the unexampled opportunities now opening before us will be met in such fashion as to make full use of our material resources. This does not imply only a high grade of purely technical direction and management, but an equally high grade of business leadership and organization and such use of governmental powers as will secure the greatest development of the great industries concerned.

Eric C. Eckel.

Southern Chemical Industry: the Economic Balance. The South a Virgin Field of Possibilities.

By COURTENAY DE KALB, Economic Geologist and Mining Engineer, Tucson, Ariz.

"THE center of population of the United States is gradually turning southward; it will continue until it rests somewhere in the Appalachian region of the Southern States."

COURTENAY DE KALB.

These prophetic words were spoken to me many years ago by our present Ambassador to the Court of St. James. Mr. Page's opinion was based on the fact that these States possessed the marvelous combination of a mild, salubrious climate, enormous agricultural and mineral resources, embracing the greatest staples required for well-balanced industrial progress, and incalculable water-power distributed over a vast area, nowhere remote from the sea, and particularly abundant along the trunk-lines of railroad communication. The estimated water-power of the Southern States amounts to 8,425,000 horse-power, or 40 per cent. more than the total water-power now developed and used in the entire United States.

Many measures of progress may be taken, but none is more often used than the consumption of sulphuric acid. This is a chemical measure. It involves the whole field of chemical activity, not in its manufacture, but in its use. In proportion to population the South is today ahead of the remainder of the country in its consumption of this acid. Nevertheless, the Southern States offer possibilities for the future so great as to make them seem practically a virgin field.

While Pennsylvania may not be included in the ranks of Dixieland, it will be admitted that Philadelphia possesses many characteristics that are more distinctly southern than northern, and in the early days of our Republic her industrial and social relations made her affiliations with the South so strong that the line of cleavage between the two sections ran across the head of Delaware Bay rather than the Chesapeake. Thus the South may claim a share in that forward vision which resulted in the organization of America's first chemical society in Philadelphia in the year 1792. It was, indeed, the first permanent association in the world devoted exclusively to chemistry. Its purposes were avowedly economic, and a clearer understanding of the intimate relations of chemistry to human progress could hardly be set forth today, yet that was eleven years before the atomic theory had been enunciated by Dalton. It was a surprising intellectual achievement for empiricists, because it must be noted that such chemistry as those men knew was chiefly an unsystematized collection of nearly isolated facts, not supported by that comprehension of fundamental principles and laws of matter by which chemists of our day are able to predict results and to move with assurance toward the solution of pressing industrial problems.

Those early Philadelphia chemists were impressed with the economic importance of their art, and that was because Philadelphia was one of the first centers of chemical industry in America. Every schoolboy has heard how Benjamin Franklin sowed his fertilizer in the shape of letters over a hillside wheat field on the outskirts of Philadelphia, so that the stimulated growth by contrast should spell out the lesson to every farmer driving along the road.

The pioneer chemical manufacturers of Philadelphia discovered, however, that native potentiality was insufficient for the founding of permanent industry. For example, white lead works were started and the product was equal to the best imported article, but the Europeans, smelling danger to their trade, began selling white lead in America at less than the cost of production at home. Accordingly, appeal was made to Congress and a protective tariff was enacted for the benefit of this and of other budding industries of the day.

Cheap power, and abundant natural resources, and technical ability, can not of themselves create chemical operations adequate to render America self-sustaining. In a world of fostered industries we must continue to foster our own children until they grow to maturity.

The Southern States should be in a position to manufacture dyes which would rob the cargo of the Deutschland of its significance. Alabama, with her great by-product coking plants, should be helping to fill this need. Economists have scolded at our criminal waste in coking coals in beehive ovens until the public has grown weary of hearing it. Future generations will look back with amazement upon us as a race of barbarians for our ruthless destruction of so much priceless treasure. Leaving apart the possibilities of producing fixed nitrogen by other means, which are justly urged as a national necessity, one heavy indictment we must face is the fact that the average nitrogen content in Eastern soils is not much, if any, above 0.18 per cent., whereas in richer, highly-productive land it should not fall below 0.3 per cent., and while the sale of nitrogenous foods from our farms is constantly hurrying us toward a nitrogen famine we are throwing into the atmosphere from beehive ovens a potential 207,000,000 pounds of fixed nitrogen every year. Of this total nearly 18 per cent. is sacrificed in the Southern States. The waste in coking also results in a loss of over 100,000,000 gallons of benzene per annum and of 3,500,000,000 pounds of tarry products, which should constitute the basis of an enormous development of diversified chemical industries.

The South has seen the beginning of aluminum manufacture in North Carolina. This is suggestive of more than the mere production of this metal. One of the paramount obligations of any community is to avail itself of its natural opportunities for converting its raw materials into finished products. When raw materials exist at a distance from the denser aggregations of population shipment to remote centers of industry is unavoidable until further development shall have changed the conditions. The law of natural exchange is possible in the United States upon a scale which has no parallel elsewhere in the world. Here is a continental nation with an endless variety of resources and with absolute freedom of interstate exchange. It points the way to the ideal status of rational world trade, for which it seems the time is not yet ripe. The fundamental principle of natural exchange is to carry the refinements of manufacture to the economic limit as near as possible to the point of production of the raw material, taking into account the relative costs of distribution of the refined as opposed to the cost of shipment of the unrefined article. The best illustration of the practical working of this law that could possibly be cited is the growth of cotton manufacturing with the aid of water-power close to the cotton fields in the South. The files of the Manufacturers Record give the history; indeed, this paper was the very spirit of the long struggle to stop the economic waste of shipping raw cotton to New England, only to pay the increased return freight on cotton fabric, plus the cost of manufacture in a region where the asperities of climate raised the cost of living and the consequent wage for labor above the prevailing prices in the more favored cotton belt. In the matter of cheap power the two sections were approximately equal; the auxiliary steam power required to carry on operations through the stages of low water were practically the same, any advantage in average precipitation and stream flow in the North being offset by the proximity of cheap coal to the Southern centers of manufacture. The argument in favor of shipment to New England consisted largely in the fact that the very dense population above latitude 40° 30' made a larger market close to the manufacturers' doors. A factor in the problem which helped turn the scales in favor of the South appeared in the surprising circumstances that the highest average freight rates in the United States exist in the manufacturing zone of New England. Accordingly, cotton goods from Southern plants can be laid down in the leading Northern markets in competition with the output from the nearer mills of Massachusetts and New Hampshire.

It will be seen that the carrying out of this principle involves the maintenance of an economic balance. That is a wholly different thing from a trade balance. The more nearly industry approximates this correct balance the more cheaply is it conducted, and the more efficiently are natural resources utilized. It is the healthiest condition of industry; it is the condition under which the greatest number of people thrive and prosper. Men have long realized that if new machinery is developed to cheapen any manufacture the old machinery must be scrapped in favor of it, else that particular enterprise will soon be swamped in the tidal wave of progress. So, too, keeping the eye fixed on the opportunities for manufacturing in the most economic locality, conditions of market and transportation being duly weighed, progressive men must be as ready to scrap their old economically worn-out factory sites as to scrap their superannuated plants. In the adjustment of enterprise to the economic balance is displayed in large measure what we call business judgment among successful men.

This lesson needs to be applied to every great article of commerce. The limit of home refining must be ascertained and the work done up to that limit, otherwise the section neglecting its opportunity is guilty of prodigality. A chain of possibilities for the South deserving consideration from this standpoint consists in the nitrogen problem, the aluminum problem and the potash problem. They are inter-related to a degree that may not immediately appear to the general public. The waste of ammonia in coking is but a part of the general problem, as in the waste in potash which the Southern cement mills have so promptly undertaken to remedy. The South is the heaviest consumer of potash, and, so far as fertilizers are concerned, her consumption of ammonia is in about the same proportion. A few years ago the production of potash from silicates, such as common orthoclase feldspar, had not been successful on a commercial scale, but today processes for its accomplishment have been brought to a state of demonstration. The Cushman-Coggeshall method con-

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COURTENAY DE KALB, native of Virginia. Classical and engineering training at Syracuse University. Geological field work, 1883-5, New York, Virginia and North Carolina. Chief chemist to Torrey & Eaton, New York, and later field assistant and metallurgist to same firm in Western States, 1885-8. 1889, sent to South America by W. R. Grace of New York. Until 1893 engaged in extensive travel through South and Central America. 1893-7, professional work in the Missouri lead-zinc region; professor in University of Missouri; also developing coal areas in Pennsylvania and West Virginia. 1897, invited to organize and become first professor of Department of Mining and Metallurgy, Queen's University, Canada. Until 1900 in this post and at same time consulting engineer to Concheno mine in Chihuahua. 1900, west coast Mexico as manager San Fernando mine and smelter. 1903, in charge of a group of mines California and Mexico. 1907, associate editor of *Mining and Scientific Press*, San Francisco. 1908, president and general manager of subsidiaries of the Pacific Mining & Smelting Co., developing comprehensive general smelting industry on the west coast of Mexico. Honorary member Peruvian National Geographical Society. Member American Institute of Mining Engineers, Canadian Mining Institute, National Society of Mines of Chile. Author "Handbook of Explosives," also technical papers on geology, ore deposits, metallurgy, etc.

sists in mixing pulverized feldspar and quicklime, wetting with calcium chloride solution and aggregating into lumps which are passed through rotary kilns heated by gas, oil or coal. The potash is converted into the soluble chloride, so that the hot clinker falling into water parts with this compound, which is leached out and evaporated. The resultant salt, made from feldspar containing 10 per cent. potash (K_2O) and 1.5 per cent. soda (Na_2O), assays above 70 per cent. potassium chloride and about 15 per cent. sodium chloride, which is equal to the imported salt in strength and in availability for use in mixed fertilizers. The Spar Chemical Co. of Baltimore recently developed a practicable process known as the Thompson method, consisting in mixing with ground feldspar appropriate amounts of acid sodium sulphate and common salt, which mixture is then brought to incipient fusion. The cooled mass is ground and leached, yielding a liquor containing sulphates of potassium and sodium. These two salts are then separated by fractional crystallization. An extraction of 80 to 90 per cent. of the original potash in the rock is thus obtained. Maryland is already sixth in the production of feldspar in the United States, so that this refining plant is logically placed.

The Gelleri process is also of promise. Ground feldspar and lime are burned and then treated with ammonium carbonate vapor in a closed chamber. The decomposition of the clinker is accomplished by treatment with water, forming insoluble lime-alumina silicate, soluble potassium carbonate and free ammonia, which latter is used for making fresh ammonium carbonate. The potassium carbonate is leached out and evaporated. The residual sludge is then reburned, yielding Portland cement clinker. These processes indicate possibilities among the many that are now being offered for the production of potash from Southern feldspar, and it must be noted that the Southern States are the largest producers of feldspar in the country.

Bauxite is a specialty, and almost a domestic monopoly, of the Southern States at the present time. To ship it almost in toto to Niagara for reduction is improvident. There is money in it, to be sure, but there is more money for the South in harnessing her water-powers to refine and reduce it at home. Wastage in freights is but one of the arguments against allowing it to go so far away. The many workmen that the aluminum industry of the South would sustain must also be taken into consideration. There are other important arguments, however. It is true of all mineral deposits that they yield their harvest but once and are then dead forever, but the case becomes more serious in the face of a material of exceptional value in our domestic economy when relatively it is extremely limited in quantity. It is to be expected that aluminum oxide produced from clays and feldspars will presently become a serious competitor of bauxite as an ore of aluminum; nevertheless, the market for bauxite will continue, and, if wisely used, not only as a source of aluminum, but incidentally as a means of obtaining fixed nitrogen as a by-product, it will have superior importance for the South. A home industry can be built upon it that will endure as long as the deposits themselves remain unexhausted.

Bauxite is not known to be forming in the United States today. It is generally agreed that it is a product of a subaerial decay of certain rocks, such as granites, syenites, diorite, diabase or any crystalline schist, under conditions of either mildly acid or mildly alkaline influences, causing de-silication of hydrous aluminum silicates, such as the kaolin formed in the decomposition of feldspars in the rocks. Sulphuric acid resulting from the oxidation of primary iron sulphides in the rocks will exert this effect; also will caustic alkalis, produced in the process of kaolinization. Sodium carbonate is likewise instrumental in the series of chemical changes that bring about the formation of bauxite, and this salt is readily formed either from carbonic acid contributed by decaying vegetable matter coming into contact with the free alkali liberated during kaolinization of the alkali-aluminum silicates, or by carbonic acid gas originally included in the minerals of the rock undergoing decomposition.

For some reason these processes seem not to operate on a large scale in temperate climates. That type of profound rock decomposition unaccompanied by removal of the products of mineral decay and favoring downward secondary concentration of alumina so often found in the tropics is rare in northern latitudes. This peculiar process is known as lateritization, and the residual deposits resulting from it are known as laterites. Mineral deposits of many kinds accumulate under these conditions. The Mayari and Moa iron deposits near Santiago, Cuba, belong to this type, bauxite being incidentally produced along with the iron ores by the removal of the silica in the alteration of the kaolin. Some of the manganese ores of Arkansas, Georgia and Virginia were likewise originally concentrated as residual masses during a past period of lateritization, however much decomposition and sorting by erosion may have enriched the deposits subsequently.

The important circumstance is that we have in the South today apparently no more than the remnants of once extensive bauxite deposits formed in Eocene time, when tropical conditions favorable for lateritization prevailed over considerable portions of the United States. In the Southern States, where there has been no glaciation to sweep the surface, only the normal erosive agents have been active, so that pockets and masses of bauxite still remain. Although intelligent exploration may result in disclosing additional resources, it is evident that the available supply of bauxite is very limited. On the other hand, leaving aside the competition from the deposits in the south of France, likewise limited in extent, the outlook for competition of a really serious kind from the lateritic areas in the tropics must be measured as part of the economic problem.

India has long been known as a source of bauxite; the lateritic zones of tropical West Africa are now being heard from, and recently the existence of deposits of bauxite has been recognized in the Cuyuni and Mazaruni districts of British Guiana. Large areas of laterite are found throughout all the Guianas, both north and south of the great Tumac-Humac range. Other similar areas are known in the middle Orinoco region of Venezuela.

The aluminum industry is in no danger of an ultimate shortage of desirable bauxite ores, but apparently the South can estimate the life of her deposits in decades. Therefore, it is important to make the most that is possible out of them. They should constitute the basis for industries utilizing the water-power of the Appalachian belt. They should sustain new communities of busy workmen. They should, however, assist in the solution of the nitrate problem for enriching the soils of the South.

One of the most interesting processes for refining bauxite, viewed in relation to the favoring conditions in the Southern States, was elaborated by Serpek several years ago, resulting in the establishment of successful works abroad. The raw bauxite is first calcined in a revolving cylindrical kiln. It is then mixed with carbon and passed through a second kiln, which is flooded with producer gas containing about one-third carbon monoxide and two-thirds nitrogen. Midway in the second kiln is a detachable electric resistance furnace, which raises the temperature to about 1800° C. The alumina is thus converted into aluminum nitride, which is decomposed by water into free ammonia, and purified aluminum oxide, ready for reduction in another electric furnace to metallic aluminum.

It will be seen how perfectly this method of Serpek fits the combination of resources available in the South. In Alabama, for example, extensive deposits of bauxite lie only 70 miles from water-power on the Tennessee River, with great coal fields between. All the necessary elements are present within a circle having a radius of 40 miles.

The Betts process likewise admits of the use of low-grade bauxite. It is even proposed to employ kaolin in this method. Iron ore and the ore of aluminum are fused in a blast furnace, making iron-aluminum-silicon. This compound is then heated strongly in the presence of silica, resulting in the formation of purified aluminum oxide, and ferro-silicon which is in demand by the steel trade.

The site for the $20,000,000 Government hydro-electric nitrate plant is practically certain to be selected within the South. The importance of this is not to be minimized. It represents the commencement of preparation for safety too long deferred, but the South must not assume that our needs will even then be fully met in contrast with the great works of a single private corporation in Norway, the Badische Anilin and Soda Fabrik, which employs in nitrogen fixation and collateral industry no less than 400,000 horse-power.

It is, however, most gratifying to see that our Government has at least perceived the fact of our impotence, and has realized our lack of resources in fixed nitrogen, which would condemn us to defeat in time of war.

An enemy will not send a gentlemanly announcement that he is coming and ask us to select seconds and prepare in the old courtly Southern style for a duel. Unless we are ready in advance, the swift tragedy, overwhelming the American people and American institutions, will be summed up as Caesar reported the fate of the King of Pontus in the laconic message, "Veni, vidi, vici." Dependent as we now are upon a driblet of domestic ammonia from gas-works and by-product coke ovens, and upon the far-away nitrate fields of Chile, it is at least comforting that a plant is to be established by the Government. The hope is that it may grow to meet our requirements.

Aside from this effort, which is in no sense a solution of the problems of home manufacture in the South for providing fixed nitrogen for its own soils and for shipment elsewhere, and for working up its own bauxite and kaolin and feldspar and the rest, individual initiative should harness many times the power which is to be used in the national nitrate plant on a peace basis. Thus the South may enrich her soils and stimulate new industries, while incidentally adding to our national resources for protection in the event of foreign complications. If individual response to such a call be slow, the several States might properly promote enterprise of this nature by suitable legislation, not favoring any particular group of capitalists nor creating a monopoly, State or other, but by offering to any enterprise undertaking to develop electric power and any enterprise that should be established to employ it in manufacturing, the encouragement of exemption from taxation for periods of ten to twenty-five years.

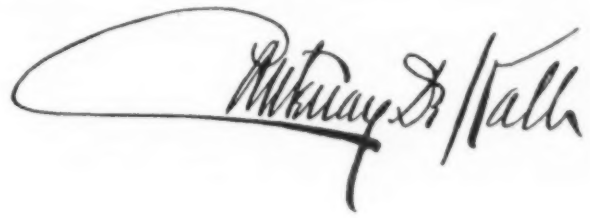
It is scarcely necessary to point out the infinite applications of cheap hydro-electric power in the manufacture of calcium carbide, cyanamide, carborundum, alundum, caustic alkali, "air-saltpeter," and other articles of commerce, nor in the manufacture of steel and special alloys, the use of which is widening so rapidly. These industries should fill the Southern valleys with thriving industrial centers. The work has begun, but, after all, no more than a bare beginning has been made. In proportion as it progresses the growth of population will encourage further development, both in manufactures and in agriculture, for enterprise is cumulative, creating larger home markets with every forward stride. The key to such expansion lies in cheap power. Whatever obstacles to its development and distribution may be imposed by individual greed or unwise legislation will retard the growth of the South toward that economic supremacy which she should legitimately attain.

The danger of too many middlemen in power development and distribution must be guarded against. Norway faced these problems, and the state regulation of her water-power has brought about development of electric energy on a scale that is making her one of the greatest industrial nations in the world. It will be recalled that the production of calcium cyanamide, originally proposed for Alabama and prevented by injudicious Federal statutes, proved economically impossible again at Niagara on the American side, but became a success just across the river. The difference lay in the lower cost of the power delivered to the consumer in Canada.

Encouraging State regulation of hydro-electric power as a public utility must constantly engage the attention of the South in order that it may not

fail to realize the benefits of its natural endowments. The South is not making the rapid strides that it should in the utilization of its water-power resources today, nor do existing laws admit of it doing so. Public interest in the question has not been adequately awakened to the facts of the situation. Knowledge of the details of the subject is not widespread. Only through organized effort, with a thoroughly informed public back of it, can progressive measures be forced through Congress and State Legislatures. Joint action by the boards of trade of the leading Southern centers might produce more prompt results. It would be useful if a commission of experts of national prominence in hydro-electric power development were appointed to study the systems in practice in foreign countries, giving the widest publicity to its findings. This might lead to a new era in the industrial expansion of the South. It is merely to delude oneself with words to talk of great power development when industries seeking a foothold in the South are driven to Canada because of legislative restrictions that prevent a rational use of the rivers running unbridled to the sea.

It has been pointed out that steam engineering is so advanced a science that a huge modern central power plant located in the heart of a coal mining region can develop and distribute electric power more cheaply than is possible under the hampered circumstances of administrative regulation surrounding water-power development in the United States at the present time. This fact alone is eloquent of the need of earnest efforts in the direction of an educational propaganda that shall liberate these natural resources of energy to the progress of industry. In such a propaganda the South is supremely interested.



Certain Minerals as the Basis of Southern Chemical Industries.*

By W. C. Phalen, United States Geological Survey.

A NOTED American chemist made the statement a little more than a year ago that "sulphur as the direct source of sulphuric acid constitutes the foundation of all chemical industries. The keystone of the structure is common salt."

W. C. PHALEN.

In view of the facts that practically all of the sulphur now produced in the United States comes from Louisiana and Texas; that the South produced 40 per cent. of the total pyrite output of the country in 1915, and that the output of salt in Louisiana, Texas, Oklahoma, Virginia and West Virginia is limited solely by the demand, it appears that the South's development as a factor in the future chemical structure of the United States need not be retarded by a scarcity of the essential raw material.

The Southern States are fortunate in their supplies of minerals most essential to certain important chemical industries. Other contributors to this number of the Manufacturers Record will tell of the South's supply of coal, iron, gas, oil, metals and certain of the non-metallic minerals like barytes. Those metallic and non-metallic minerals which occur in abundance in the South and are most closely allied to important chemical industries—for example, sulphur, pyrite, salt, phosphate rock and bauxite—will be outlined below, the object being to bring out their abundance and availability as raw material in chemical manufacture.

Aside from the supplies of fuel in the form of coke, coal, oil and gas, the relative cheapness of water-power stands as the most important factor in determining the locations of manufacturing and electro-chemical industries. Niagara Falls and the Southern New England States are concrete examples which prove the truth of this assertion. Some very interesting tables have recently been published showing that the Southern States have about seven million horse-power, or approximately one-eighth of the total available power to be developed along our streams. Recently compiled and printed information also shows that in 13 out of 14 Southern States the developed water-power amounts to less than 900,000 horse-power, or approximately one-eighth of its potential possession. Besides an abundant fuel and potential water-power supply, the expected increase in our South American trade, good harbors and the proximity of the Panama Canal should powerfully stimulate the development of chemical industries in the Southern States.

Cheap hydro-electric power is essential in the aluminum industry. The raw material or mineral from which metallic aluminum and aluminum salts are now made is bauxite. The production of this important mineral in the United States in 1915 was nearly 300,000 tons, valued in the raw state at the mines at more than a million and a half dollars. This means the production of bauxite in the Southern States, for the mining of this mineral is strictly a Southern industry and such it has been since its inception in the United States. More than 90 per cent. of the total bauxite marketed in this country in 1915 came from Arkansas, and the other 10 per cent. came from Georgia, Alabama and Tennessee.

The uses of bauxite are somewhat restricted, though of great importance. The making of metallic aluminum stands first, and certain steps in the manufacture of this metal constitute a chemical industry in so far as they involve the preparation of chemically pure alumina. The numerous products entering into the preparation of alumina and aluminum, such as soda, caustic soda and petroleum coke, cannot be discussed, but their manufacture constitutes chemical industries of great importance, of which the South's share is limited.

The making of a long list of aluminum salts, among which aluminum sulphate and the alums proper stand next in importance, is a strictly chemical industry, and the manufactures of abrasive alundum and bauxite brick are important and growing.

Until very recently nearly all the bauxite mined in the South has been shipped north for refinement and reduction to the metal and for the manufacture of aluminum salts, especially the alums. Conditions are changing. The reduction plant of the Aluminum Company of America at Marysville, Tenn., was placed in operation about two years ago, the power used coming from Parksville and Hales Bar. One of the most important developments in the aluminum industry in 1915 was the taking over by the Aluminum Company of America of the property of the Southern Aluminum Co., near Whitney, N. C. This company, a French concern, had to close down owing to troubles in Europe. The Aluminum Company of America now has a large force of men pushing operations as rapidly as possible, and it is expected that metal will be coming from the plant late this year or early next.

It is reported that the erection of dams for the Aluminum Company of America's project on Little Tennessee River, near the border of North Carolina and Tennessee, will be begun this year, and already preparations are being made for a cement plant in connection with the work at Chilhowee, Tenn.

The development of the purely chemical industries, like the manufacture of the alums and other aluminum salts, has lagged in the South, in spite of the fact that all of the necessary raw material is found in that section. One of the requisite chemicals in this manufacture is sulphuric acid, and, according to the very latest and reliable statistical information of the United States Geological Survey, nearly one-third of the total sulphuric acid of the United States is now manufactured in 10 out of 14 Southern States. Here, again, the signs of the times indicate some progress, as the plans to establish an alum plant at Gordon, Ga., indicate. With all the necessary raw material in the South, a pertinent question is: Why should it not have its aluminum salts industries, at least to the extent of its own legitimate requirements?

For several years attempts have been made to obtain pure alumina and in turn metallic aluminum from its combinations with silica in the silicates like clay. When this is successfully accomplished it is a safe assumption that the abundance of low-grade bauxite mined in the South will be utilized. There is no means of ascertaining just how much of this material is scattered about old and abandoned mine dumps, but the quantity is known to be large.

The two States Louisiana and Texas produce practically the entire sulphur output of this country, and they yield more than enough of this commodity to supply domestic needs. Thirteen years ago this country was dependent upon Sicily for its sulphur supply, but with the application of the Frasch process for the extraction of sulphur from its beds commercial conditions have been reversed, and Louisiana sulphur prior to the war found an important and growing outlet in the European market. In 1912 another important sulphur mine began operations at the mouth of the Brazos River, Texas, and this enterprise has continuously expanded up to the present time.

The method by which the sulphur is obtained will not be discussed. It is sufficient here to say that immense quantities of water and fuel oil are needed

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MINING BAUXITE AT MINES OF ALUMINUM COMPANY OF AMERICA, SALINE COUNTY, ARKANSAS.

and the exceptional conditions along the Gulf coast for supplying these essential accessories would be difficult to improve. The facilities for shipment of sulphur to the Eastern and Southern markets are also good, as the deposits are located very near to or on deep water.

Sulphur is used in a variety of chemical industries and enters into a great diversity of products. Owing to its property of taking fire at low temperatures, it is used in friction matches, fireworks and powder. It is also used in making ultra-marine and carbon disulphide. Wool, silk, sponges and straw are bleached with it or from its gaseous derivative, sulphur dioxide. Certain food products are preserved with it or compounds made from it. Rubber is vulcanized with it. It is used in medicine and in preparations for spraying growing vegetation. It is used in the manufacture of sulphuric aicd and in making sulphite paper pulp. Though sulphuric acid is made principally by burning pyrite, there has been a growing tendency to use sulphur, especially since the war in Europe has caused an abnormal demand and a consequently high price for this commodity. The list of chemicals in which sulphur enters is a long one, and with the raw material on the ground it would appear that to have a share in the chemical industries depending on it is a legitimate aspiration of the South.

By far the greater part of the sulphuric acid made in this country involves the use of pyrite, which is imported in part from Spain and Portugal and in part produced at home. Sulphuric acid is considered the gauge of the activity of a country in chemical manufactures in general. Imported pyrite is as available to the South as to any other section of the United States. The Southern States produced 40 per cent. of the total domestic production of pyrite in 1915, which amounted to 394,124 long tons, and Virginia ranks first among the producing States. The above figures do not involve the sulphides mined near Ducktown, Tenn., for their metallic copper and which in recent years have contributed notably to the domestic production of sulphuric acid. Ten Southern States out of 14 produced nearly a third of the total production of sulphuric acid in 1915. Tennessee ranked first, and the plant of the Tennessee Copper Co. at Copperhill produced more sulphuric acid than any other single plant in the United States and probably in the world.

The list of uses of sulphuric acid is too long to incorporate in this paper. The principal tonnage of acid is used in the fertilizer industry, which consumes nearly 75 per cent. of it. The petroleum products industry, the iron, coke and coal industries and the war-munitions industry are important consumers, and a long list of chemicals in which sulphates may or may not appear in the final product consumes the rest. The South has its share of the fertilizer industry and there has been a marked advance in recent years in the other main industries mentioned, but in those smaller but in the aggregate vastly important chemical industries the South's history, like that of the nation, is still largely to be made.

The fertilizer industry, as conducted at the present time, is pre-eminently a chemical industry. Into it enter phosphate rock, sulphuric acid, nitrogen in different compounds and potash salts. The chemical potentialities of the South, so far as sulphuric acid is concerned, have been outlined. The status of the South with reference to phosphate rock makes even a better showing. With the exception of the Western group of States, represented by Montana, Wyoming, Utah and Idaho, all the important phosphate rock deposits of the United States are found in the Southern States—namely, Florida, Tennessee, South Carolina, Arkansas and Kentucky—and the first three States named produce more than 99 per cent. of the total phosphate rock consumed in or exported from the country. No general statements regarding the Southern phosphate rock industry should be based on the history of this industry since the outbreak of the European war, for conditions in this industry since August, 1914, have been exceptional and abnormal. During the preceding year, 1913, there was a marketed production of more than 3,000,000 tons of phosphate rock, with a value of nearly $12,000,000. Of this production 82 per cent. came from Florida, approximately 14.5 per cent. from Tennessee and approximately 3.5 per cent. from South Carolina. The figures for 1914 and 1915 naturally are different, owing to interference with the exportation of Florida phosphate rock because of the European war.

During the banner year in the phosphate rock industry, 1913, 44 per cent. of the rock was exported. This means the highest grade rock. A word of warning here seems necessary against a practice which results in selecting the cream of the product for export, leaving the low-grade rock to be worked up by our own fertilizer manufacturers after the best rock is gone. Though the total reserves of phosphate rock in the United States are very large and will probably last several generations, even with a continuously increasing production, the supply of high-grade rock, especially in the Southeastern States, is by no means inexhaustible, even using this much-abused word in the relative sense.

The writer cannot forbear mentioning in this place a factor in the fertilizer industry bearing a close relationship to future Southern phosphate rock supplies; that is, the conservation of low-grade phosphate rock by chemical means. There is associated with the larger important phosphate rock deposits considerable rock that is not up to present commercial requirements in its content of calcium phosphate, "bone phosphate." There is also being produced in connection with the preparation of commercial phosphate rock for market a great deal of low-grade material. To bring this class up to commercial grade, or to a content of 70 per cent. or more calcium phosphate, various chemical methods have been suggested. The time will undoubtedly come when chemical methods will have much more extended application than at present, and there will then result the conservation of a great deal of phosphate rock now consigned to the waste pond. Such methods are of more than ordinary interest in connection with the low-grade Southern and Western rock, owing to the high cost of transporting such rock.

GORGE OF LITTLE TENNESSEE RIVER, BETWEEN NORTH CAROLINA AND TENNESSEE, WHERE HYDRO-ELECTRIC POWER MAY SOON BE DEVELOPED.

CONSERVATION OF RESOURCES BY REWORKING PHOSPHATE ROCK PREVIOUSLY MINED, NEAR MT. PLEASANT, TENN.

The large quantity of sulphuric acid available in the South and potentially so in the West, and which should become available in increasing quantities as time goes on, is another important element in this situation. The chemical method of concentrating low-grade phosphate rock, and thus enabling it to be transported long distances, will probably be worked out in the Western field, but, whether solved there or elsewhere, it will be the means of conserving enormous quantities of low-grade rock both in the Southern and Western States. The importance of this chemical conservation of phosphate rock to the South cannot be closely estimated, but it certainly should be great.

An interesting recent development in the utilization of low-grade phosphate rock is the production of phosphoric acid and its derivatives—namely, ammonium phosphate and double super-phosphate—by utilization of the electric furnace. The sulphuric acid is here replaced by silica, coke and electric energy, and with cheap electric energy the resulting products may be produced considerably cheaper and in a much more available form than by present methods. Thus two of the three important fertilizing elements—namely, nitrogen and phosphorus—are combined in one compound. The electric fertilizers, fixed nitrogen and available phosphoric acid go hand in hand with cheap electric power.

The two other ingredients besides phosphorus entering into complete mixed fertilizers are nitrogen and potash salts. Nitrogen is furnished in the form of nitrates, ammonium salts, cyanamide, etc. Our mineral nitrate is imported from Chile in the form of sodium salt. The Gulf ports should have an advantage in freight rates now that the canal is in working order. The manufac-

PYRITE MILL IN LOUISA COUNTY, VIRGINIA.

ture of ammonium sulphate from coal will be discussed by another contributor. The use of calcium cyanamide or lime nitrogen has become an important source of nitrogen in fertilizers. It is estimated to be used by more than 300 fertilizer manufacturers in the United States and to be a source of organic nitrogen in about 25 per cent. of the total ammoniated fertilizer mixtures now in use. Its manufacture depends on cheap hydro-electric power. The raw materials involved in its manufacture are limestone, coke and atmospheric nitrogen. The South's reserves of coking coal and limestone are well known and are described in another part of this issue, and the magnitude of her potential hydro-electric power has already been touched upon. It would appear, therefore, that the South's opportunities for the manufacture of nitrogenous fertilizers are excellent.

Our present domestic potash salts industry is of small importance, but by-product potash from cement mills and blast furnaces and the successful extraction of potash salts from feldspar, sericite and similar raw materials may quickly change this condition. The liberation of soluble potash salts from ground feldspar, making use of the hydro-fluoric acid generated by the treatment of Florida phosphate rock with sulphuric acid, may prove of great importance. Fluorides have been considered deleterious ingredients in phosphate rock, due to the fact that in making superphosphates additional sulphuric acid is consumed and thus wasted, and for the additional and very important reason that the hydro-fluoric acid which is liberated is dangerous. If this obnoxious gas occurring in low-grade phosphate rock can be utilized in making available or soluble the potash content in such rocks as feldspar, the results may be of far-reaching importance. The South has an abundance of potash-bearing silicate rocks, and some Florida phosphate rock is known to carry from 1½ per cent. to more than 3 per cent. fluorine. If necessary, fluorine-bearing mineral, like fluorite, might be added.

The five Southern States which produce salt on a commercial scale, named in the order of their importance, are Louisiana, Virginia, Texas, West Virginia and Oklahoma. In 1915, the latest year for which statistics are available, the output of salt in the States mentioned amounted to more than 450,000 short tons, or nearly 3,250,000 barrels of 280 pounds each, valued in round numbers at nearly $1,000,000.

In Louisiana the salt occurs in two districts, (1) in the northern and north-central part of the State in the valleys of the Red and Sabine rivers, and (2) in the southern part of the State. The most important known deposits and those worked at present occur in close proximity to the Gulf coast. Rock salt is the product mined at Weeks and Avery's Islands, located in Iberia Parish close to the Gulf of Mexico. The salt mined in Louisiana is of an exceptionally high degree of purity and the output is limited solely by the demand. The salt occurs in so-called "mounds" which, though of limited extent, extend to great depths. Cheap fuel in close proximity, limestone in the central part of the State and an ample water supply furnish some of the mainstays of an important alkali or soda industry.

The only economically important deposits of salt found in Virginia occur in the southwestern part of the State. These, with gypsum deposits, extend for 20 miles along the fork of the Holston River and have been developed quite extensively in Smyth and Washington counties. Two gypsum plants and an alkali works—the Mathiesen Alkali Co., which uses the brines—are in operation in this area. Saltville, Smyth county, is the center of the industry, which furnishes a good example of what may be done in other parts of the South where salt occurs in abundance.

The important salt industries of Texas are located near Palestine, Anderson county, and at Grand Saline, Van Zandt county, in the eastern part of the State. Some solar salt was reported in 1915 from Crane county and from Colorado, Mitchell county, in the west. The bulk of the salt now marketed in Texas is the evaporated article, produced either in grainer or other types of artificial evaporators. Considerable salt comes also from inland salt lakes and from bayous along the Southwest coast. The occurrences of salt indicated do not include the immense deposits found in recent years in drilling operations in Northwest Texas. The United States Geological Survey has done some deep drilling in this region in the vicinity of Amarillo, near the locality where potash-bearing crystals of red salt have been obtained. The salt in this region is too remotely located to be of present importance, but the possibility of finding potash salts in quantity is worthy all efforts, since the discovery of potash salts in large quantity would be of great importance not only to the chemical and fertilizer industries of the South, but to the entire country.

In West Virginia the salt industry and the associated bromine and calcium chloride industries are confined to a small area near Mason and Hartford, Mason county, on the Ohio River, and to Malden, on the Kanawha River, a few miles above Charleston, the State capital. The product is evaporated salt produced by the grainer process. After the salt is removed, the resulting bittern is treated with sulphuric acid and sodium chlorate and the bromine extracted. The residue is evaporated to a viscous liquid, is run into metal drums and shipped as calcium chloride.

It is certain that the West Virginia bitterns offer greater opportunities for the building up of chemical industries than have been taken advantage of to date. Brines similar to those of Mason county are also found and worked across the Ohio River in the State of Ohio. At both the West Virginia localities the raw material is found on important navigable rivers and on trunk railroad lines. Thus transportation facilities are unexcelled. In Mason county especially coal is mined on the ground; indeed, it is the refuse coal that is employed in the evaporation of the natural brine. Such a combination as excellent transportation facilities, coal on the ground and a brine containing not only salt but bromides and calcium and magnesium salts is one offering exceptional opportunities which cannot be duplicated in many other localities. The following analyses indicate approximately the character of the salts contained in the natural brines of the Ohio and Kanawha valleys:

Analyses of Certain West Virginia Natural Brines.

Conventional combinations in percentage of anhydrous residue.

	1.	2.
KCl	.41	.29
NaCl	67.09	72.82
$CaCl_2$	7.77	17.23
$MgCl_2$	23.99	7.58
Na_2SO_4	.00	.00
$MgSO_4$	.00	.00
$CaSO_4$	.00	.89
$MgBr_2$	.71	1.19
NaBr	.00	.00
	100.00	100.00

1. Dixie Salt Works, Mason, W. Va.
2. J. Q. Dickinson & Co., Malden, W. Va.

After the removal of the salt (NaCl), the bromine, together with more soluble salts, such as the chlorides of calcium and magnesium, remain in the bittern in much larger proportion than in the original brines. The opportunities for making important chemicals such as the bromides of sodium, potassium and ammonium; the magnesium salts, including the chloride, sulphate, carbonate and oxide, and even metallic magnesium, the manufacture of soda bleaching powder, hydrochloric acid, chlorine, sodium sulphate, etc., together with certain organic chemicals, seems worthy of the closest study. The opportunity which appears to exist in this section of the Ohio and Kanawha valleys for building up an important chemical industry ought not to remain neglected.

W. Phalen

A PICTURE FOR PATRIOTS.

These activities, showing in the shape of substantial industries in all of the above lines, radiating like spokes of a wheel from the hub of central power production along the beautiful Tennessee River, present a picture of future possibilities attractive and desirable not only to those engaged in such work, but to all patriotic citizens who believe to the fullest that in time of peace we should prepare for war.—Dr. H. D. Ruhm, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

The By-Product Coking Industry in South.

Military Preparedness Demands Development of Dye Manufacturing in South.

By C. E. LESHER, United States Geological Survey.

ONE of the most striking lessons to the American people coming from the experience of two years' European conflict is the need for the fullest development here of the chemical industries which in time of peace furnish us dyes, chemicals and drugs, and in time of war will supply the absolutely essential high explosives. The absence of such industries in the United States with sufficient capacity to meet domestic needs is in nowise the fault of the chemist. The various tariff laws and trade conditions that in the past have hindered, even throttled, development were beyond the power of the manufacturer to control. It is pretty generally recognized now that years are required in which to develop the processes and train the workers; that buildings and plants covering acres of ground and costing millions of dollars are necessary before dyemaking and allied processes can be developed to the highest efficiency. In the two years that have elapsed since the war cut off our main supply of these materials much has been done in this country in the way of the education of the Congress, of capital and the people as to the need and requirements of the chemical industry, and during that time substantial progress has been made in actual production.

CARL E. LESHER.

Doubtless others, more familiar than the author with the actual details, will chronicle elsewhere in this issue of the Manufacturers Record this progress in dyes and explosives manufacture. It is the purpose of this paper to tell of the contribution of the South and point out some of the future possibilities in this very important line of chemical endeavor.

Benzol and toluol—or, in the precise terms of the technical chemist, benzene and toluene—are the two most important raw materials in the category of the dyes and explosives chemist. These substances are oils, quite similar to gasoline physically but differing greatly chemically, and are obtained by distillation from either coal or petroleum. The recovery of benzol and its homologues from petroleum is but past the experimental state, and this country and, in fact, the world now depends mainly upon coal and the by-product coke oven for these oils.

Benzol is commonly thought of as a coal-tar product, whereas it is in fact obtained from coal gas in vastly larger quantities than from coal tar or water-gas tar. Somewhat less than 1 per cent. by weight of light oil can be washed from the coal gas, a quantity from five to ten times that ordinarily available in the coal tar from the same amount of coal.

In 1915 benzol and similar oils were recovered from coal gas at 30 by-product coke plants, and more than 16,600,000 gallons were produced. Four of the 30 plants are in the South, in the Birmingham (Ala.) district, and from those four plants between 15 and 20 per cent. of the benzol from coal gas was obtained in 1915. Two of the plants are operated by the Semet-Solvay Co.; one, of 60 ovens, for the Central Iron & Coal Co., at Tuscaloosa, Ala.; the other, of 240 ovens, for the Tennessee Coal, Iron & Railroad Co., at Ensley, Ala. The last-mentioned company also owns and operates 280 Koppers ovens at Fairfield, and the Woodward Iron Co. owns and operates 170 Koppers ovens at Woodward. These plants are all in the Birmingham coal and iron district and within short distances of the city of Birmingham.

These Solvay plants have been equipped for the recovery of benzol from the gas for a number of years, as have the numerous other Solvay plants throughout the country. The Tennessee Coal, Iron & Railroad Co. erected in 1915 a large, complete and permanent benzol plant at a cost, it is reported, of $1,000,000, and began the production of benzol about October 1. When, shortly after the beginning of the war, Thomas A. Edison found his supply of certain chemicals, as phenol or carbolic acid (which may be derived from benzol), shut off, he promptly planned to render himself independent in that regard, and built two benzol plants, one in connection with the coke plant at Woodward, Ala., and the other in Pennsylvania. The Woodward Iron Co. shortly thereafter erected a plant of its own to recover the oils from the gas not treated by Edison, and began operations about the first of June, 1915.

The removal of benzol from the coke-oven gas does not greatly decrease the heating value, but does diminish the candle-power value, so that gas for municipalities which must meet certain requirements in the way of candle-power is not in general deprived of its light oils. The battery of 14 Roberts flueless ovens at Chattanooga, Tenn., which began operations in 1915, supplies gas for domestic purposes to that city, and no benzol is taken from the gas.

The recovery of benzol is but incidental to the main purpose of coke ovens, namely, to supply coke to iron furnaces. Benzol and its homologues, in turn, except for their use as motor fuel, are but the raw materials, the starting point in the chemical industry. There are about 10 oils, as benzene, toluene, xylene, etc., that can be obtained directly from the crude light oil washed from coke-oven gas. From these basic oils a long line of chemical products are made—hundreds, in fact—including not only the dyestuffs, but also explosives, medicines and photographic chemicals. It is to the possibility of future development in the South of the processes by which these complex chemicals are made that the attention of the chemists should be directed.

No one realizes more fully than the modern chemical engineer the task that confronts those who attempt to establish such industries in new fields. Raw materials, cheap power and markets are essential. Of raw materials the supply of benzol oils may be considered sufficient for even more than a beginning, and sulphuric acid is also available. Those who are familiar with the situation claim for the South great undeveloped hydro-electric power possibilities, and with cheap power and the salt that occurs in the region, hydrochloric acid, chlorine and chlorine compounds, so vital to the chemical industry, are assured.

Nitric acid is as necessary as benzol in making dyes and explosives. The United States is now dependent upon the nitrates from Chile for this acid, and will be dependent until processes are developed either for the fixation of atmospheric nitrogen or the oxidation to nitric acid of the nitrogen in the ammonia from coal. Either method under proper conditions is feasible, the prime necessity of the first being very cheap electric power, and of the other, a supply of ammonia. The South can supply both.

Important as are benzol products, their value at the works in 1915 was exceeded by the value of the ammonia obtained from the by-product coke ovens. It is true that not all by-product plants recovered benzol and that the greater part of the apparatus for recovering light oils was not in operation until late in the year (1915), whereas ammonia was obtained at all of the coke establishments throughout the year; but it should be remembered that prices of benzol were above normal, and for that reason these products represented a larger proportion of the total value than would otherwise have been the case.

Ammonia in the form of sulphate is a fertilizer of great value and one of which large quantities are consumed in the United States annually. To quote C. G. Atwater, manager of the agricultural department of the Barrett Company, ammonium sulphate "is an important carrier of nitrogen for agricultural use and is a component of most mixed fertilizers produced in this country. It is generally accepted as one of the principal forms of nitrogen in all agricultural countries, and is shipped all over the world for this purpose. * * * It is the most immediately available source of chemically combined nitrogen that the country has at its disposal and is one of our most valuable natural resources from this point of view."

Mr. Atwater estimates that the available nitrogen recoverable in the form of ammonia from an acre of bituminous coal four feet thick is sufficient to maintain the fertility of an acre of soil for 640 years.

The South is a large user of fertilizer, and is, of course, interested in a continuous, dependable and cheap supply. The annual output of coke in Alabama is around 3,000,000 net tons, of which, in the past two years, two-thirds has been made in by-product ovens. On the basis of 26 pounds of ammonium sulphate per ton of coke, the annual sulphate production in Alabama from by-product coke ovens is approximately 26,000 tons, and, if all the coke were so made, the output of ammonium sulphate would be in the neighborhood of 39,000 tons. With the million tons of coke that are made each year in beehive ovens in Alabama, 13,000 tons of ammonium sulphate are forever lost. About 500,000 tons of coke a year are made in Kentucky, half of which comes from by-product ovens; about 300,000 tons are manufactured in Maryland in by-product ovens, and of the 1,400,000 tons supplied by West Virginia approximately 200,000 tons are made by the improved process. The coke from Georgia, Virginia, and until 1915 from Tennessee, amounting in round numbers to more than 920,000 tons, is from beehive ovens. These seven Southern States produced 6,366,000 tons of coke in 1915, of which 2,947,000 tons, or 46 per cent., were made in by-product ovens, which is a better record than for the United States as a whole, for but 34 per cent. of the total output came from ovens of that type in 1915. More than 5,000,000 tons of coal were carbonized in the beehive ovens of these seven States in 1915, and no less than 44,000 tons of ammonium sulphate, 8,000,000 gallons of benzol products, 35,000,000 gallons of tar and millions of cubic feet of gas were wasted. The value of this waste is of course hard to estimate, but, based on the average for 1915, it would have reached the sum of $8,000,000. With that figure in mind one can appreciate the importance of the waste that is now going on in the carbonization of coal and can realize the possibilities of real conservation in the South in this regard.

C. E. LESHER is a graduate engineer in metallurgy from the Colorado School of Mines. For the past six years he has been connected with the United States Geological Survey, and since July, 1915, has been in charge of the work on coal and coke in the Division of Mineral Resources. Prior to his connection with the Federal Survey Mr. Lesher spent a year in British Columbia, engaged in experimental work on electro-thermic zinc smelting, and later did research work on a large scale in Illinois on the fixation of atmospheric nitrogen.

There are many ramifications of the chemical industries that depend upon coke by-products. Their future development in the South depends more upon markets than upon any other factor. It has been shown that the South is farther advanced in the proper utilization of coal than is the United States as a whole; that raw materials in the form of benzol oils, tar and ammonia are available in sufficient quantity, and that there are latent sources of these materials awaiting only the opportunity for profitable exploitation. The South is a good market for fertilizers and could doubtless absorb much more sulphate than is now produced in the region.

There is the possibility of progressively greater development of textile industries using aniline dyes, and consequently the possibility of profitable manufacture in this region. There is added argument for this from a material standpoint, in that the dye works are readily converted into plants for the manufacture of military explosives, and, should this country ever be engaged in armed conflict, a source of supply of such explosives in the South would be relatively free from attack by invaders.

An industry in these products in the South must be expected to develop slowly, for it will depend upon demands that are constantly shifting and will involve methods and processes undergoing constant change and improvement. Economic considerations may delay the beginning of such industries so far from the main centers of population and trade, but as a measure of military preparedness there is every reason to favor the South in aniline dye manufacture, and the Government, the chemist and the capitalist should fully recognize the potential resources of that region.

C. H. Herty

The Resources of the "Clinchfield" Country as a Foundation for Chemical and Industrial Interests.

By Victor V. Kelsey, Chemist and Geologist, Carolina, Clinchfield & Ohio Railway, Johnson City, Tenn.

THE geographical location of the Carolina, Clinchfield & Ohio Railway is one that commands the attention of the manufacturers in the North and Middle West, for the fact that the Clinchfield is the connecting link, as it were, between the central West and the Southeast, and with its various railroad connections affords a most direct route from northern points to the South and Southeast, and provides a ready outlet for finished products originating in the southern Appalachian territory to the large consuming centers in the North and central West.

VICTOR V. KELSEY.

To no less a degree does the geological location of this railroad direct the attention of the chemist, chemical engineer, geologist and manufacturer, passing, as it does, directly across four great mountain chains of the southern Appalachian Mountains, viz., the Cumberland, Clinch, Great Smoky and Blue Ridge, thus bringing together within a very narrow compass the vast and varied potentialities of the major geological measures in eastern Kentucky, southwest Virginia, eastern Tennessee, western North Carolina and South Carolina.

The natural resources of this section, made complete by a bracing and healthful climate, wholesome water, an abundance of good agricultural products and excellent railroad facilities, present a condition almost without parallel in this country for the production of a great variety of chemicals, chemical compounds and electro-chemical and metallurgical products.

The economic and profitable production of all manufactured commodities depends fundamentally on several factors, the most important of which are cheap power, readily available raw materials, transportation facilities, good markets and efficient labor. The territory tributary to the Clinchfield abounds in these.

The profitable winning and preparation of raw mineral products and their subsequent manufacture into finished articles is largely augmented by cheap power.

The opening up of the vast coal fields in southwest Virginia and eastern Kentucky insures an unlimited supply of high-grade coal suitable in every way for steam, gas and domestic purposes, and well adapted for use in the production of various chemical compounds. These coals, containing upwards of 14,000 British thermal units per pound, with less than 1 per cent. of sulphur and very low in phosphorous and ash, commend their use to the chemical and metallurgical manufacturer.

The coals in the Clinchfield district are excellent coking coals, and large tonnages find their way to the coke ovens in southwest Virginia, thus providing another source of cheap fuel along the Clinchfield and valuable by-products for chemical and metallurgical processes. The yield of coke and by-products from the Upper and Lower Banner seams and the No. 4 seam in the Clinchfield territory will average as follows:

Coke	72%
Gas, cubic feet	10,000
B. T. U. per cubic foot	600
Tar, gallons	12-14
Ammonium sulphate	22

V. V. KELSEY, born in Ohio; graduated from Virginia Polytechnic Institute, 1909, with B.S. degree in course of Applied Chemistry and Geology; associated with Carnegie Steel Company, at Duquesne, Pa., during summer and fall of 1909; resigned to become chemist for Virginia Iron, Coal & Coke Company, Roanoke, Va.; appointed chemist for Carolina, Clinchfield & Ohio Railway, 1910; member American Chemical Society, and junior member American Society for Testing Materials.

Another important source of fuel is that of charcoal, with its valuable by-products of wood alcohol and acetate of lime.

The Southern hardwoods in the Appalachian belt are capable of furnishing ample material for destructive distillation plants, and the slabs and other mill wastes from such species as the beech, birch, oak, gum, ash, elm and hickory are well adapted to the production of charcoal and its by-products. This means the utilization of tremendous wastes from sawmills and their conversion into wood alcohol and acetate of lime, the charcoal being used in blast furnaces; in the manufacture of gun powder; in sugar refineries; for insulating material; as a domestic fuel; by tin and copper smelters, and for other chemical purposes. Acetate of lime finds extensive use in the production of acetic acid, acetic ether, commercial acetates and acetone. Wood alcohol finds use in the manufacture of shellacs, varnishes, formaldehyde, photographic films, celluloid, soap, coal-tar dyes, etc.

In addition to the fuels enumerated above, there are available opportunities for hydro-electric development on the Clinch, Holston, Nolichucky, Toe, Linville, Catawba and Broad rivers, which is a source of useful and cheap power essential for the production of such chemical commodities and electric furnace products as chlorine, bleach, artificial graphite, carborundum, alundum and other artificial abrasives; cyanamid and nitric acid; ferro alloys, such as ferro-chrome, ferro-silicon, ferro-manganese, ferro-titanium, etc.

The Clinchfield traverses a section rich in beautiful stones of a wide variety and abundance, suitable for building, decorative, road building and other purposes. These are sandstone and quartzite, slate, limestone and marble, granite and gneiss, serpentine, flagstone and trap rock.

The sandstones and quartzites are found in workable quantities at many places on the Clinchfield. They are of fine, even texture, easy to work, and present a variety of color, including white and various shades of gray and buff.

Slate suitable for roofing and other purposes is found in several localities adjacent to the Clinchfield. It is argillaceous, fine-grained and of a dark-bluish color. The cleavage is strong and independent of stratification.

Limestones are found in stratified beds of great thickness at various places in Virginia, Tennessee and North Carolina on the Carolina, Clinchfield & Ohio Railway. They vary in chemical composition from practically pure calcium carbonate, containing upwards of 98 per cent., to almost pure dolomite, containing 55 per cent. of calcium carbonate and 45 per cent. magnesium carbonate. Between these extremes are to be found an abundance of limestone, containing varying per centages of calcium and magnesium carbonates. The stone in different sections varies in color from light gray to dark bluish-black. The hardness is more or less uniform throughout the territory, and the stone resists weathering to a remarkable degree. The marbles of this section are associated principally with the shady limestone, with the exception of a beautiful white marble in the Carolina gneiss in Mitchell county, North Carolina. This white marble is apparently free from joints, is of a medium grain and texture, and takes a high polish. The marbles of the shady limestone are of a fine, even grain and texture, take a high polish, and vary in color from almost white to blue, with workable beds of a brown mottled marble, which equals and probably excels the famous Italian marble.

The granites and gneisses of the Clinchfield are confined to the crystalline area, which extends more or less continuously from Poplar, N. C., to Spartanburg, S. C., a distance of 129 miles. This belt contains the Carolina and Roan gneiss, portions of which are suitable for flagstones. The granites vary in texture from fine crystalline to medium crystalline. The Beech and Cranberry granites in the section between Poplar, N. C., and Marion, N. C., are very finely crystalline, hard and dense, and vary in color from pink to a dark bluish-gray, the rift and grain being well marked. These stones are suitable for building, ornamental and road metal purposes. At Harris, N. C., is a large area of granite, admirably situated for quarrying, of a uniform gray color, medium, even texture, of good weight, strength and hardness, with well-defined rift and grain. The conditions here are such as to make this deposit a very attractive quarrying proposition.

The serpentine tributary to the Clinchfield takes a fine polish, and presents an ornamental stone of great beauty.

The trap rock of this section comprises material suitable for road metal, and the Carolina gneiss affords considerable material for flagstones.

The artificial building materials that are being produced in large quantities at Kingsport, Tenn., are Portland cement, quick and hydrated lime, brick and hollow building tiles.

A number of sawmills and woodworking plants located at various points on the line cut and finish a great variety of hard and soft woods.

The pure calcium and dolomitic limestone beds, so situated for economic quarrying, constitute the basic material for use in the production of a large number of heavy chemicals, such as Portland cement, quick and hydrated lime, soda ash, glass, fertilizers, ceramic products, fluxing compounds, etc. These immense limestone beds are of vast economic importance, and play a most important role in various chemical industries. Their geographical location and extent on the Clinchfield are such as to render them most useful, inasmuch as they do not have to be transported long distances, and, in fact, a number of factory sites are adjacent to some of the largest deposits.

The feldspars and feldspathic materials in the immense pegmatite dikes, just a few miles south of the limestone measures, embrace a natural commodity used in ever-increasing quantities by producers of china, semi-porcelain, porcelain and granite wear, and to somewhat less extent by glass, scouring soap, wood filler and fertilizer manufacturers.

The large deposit of pure white silica sand at Kermit, Va., is a potentiality of considerable magnitude and importance. This body of sand is sufficiently high in silicia and free from iron and other deletorious compounds as to render it useful in the production of the highest grades of glass, pottery ware, artificial abrasives, ultramarine blue, paint fillers, wood fillers, scouring soaps, cleansing compounds and other products requiring a high silica sand. This sand is so situated with reference to the surrounding topography and the railroad to permit its being won and ground at a minimum cost. Its closeness to the feldspar, limestones, salt, clays, fluorspar, high-grade fuels and soda ash renders it a valuable commodity for the fact that it can be combined with these materials and converted into the manufactured articles listed above, all of which represent finished products that are being used in large quantities in all parts of the country. Industries designed to produce these articles, especially glass, pottery, artificial abrasives and ultramarine blue, should flourish from their inception.

Another important source of high-grade silica is the quartz associated in large quantities with the pegmatite dikes in North Carolina. This quartz is in every way equal in its chemical and physical properties to the Kermit sand.

The large deposits of residual and sedimentary clays and the extensive beds of shale on the Clinchfield are the sources of material of vast economic importance. These are now being utilized in the production of a number of finished commodities, and the completion of the large chinaware pottery at Erwin, Tenn., marks an epoch in the industrial development in the South.

The Southern Potteries Corporation, organized in May of this year, has now well under way a large seven-kiln pottery, designed to manufacture high-grade decorated tableware. The owners of this pottery decided to locate their plant on the Clinchfield in order to take advantage of the raw materials necessary for pottery production that exist in the territory served by the Clinchfield. There is no pottery center in the United States that has the advantages of logical location relative to raw material and a market for the finished product that the pottery at Erwin has. This new pottery center is located in a territory rich in kaolin, clays, feldspar, flint and high-grade coals, which are exceptionally low in sulphur, thus giving this location a decided advantage over those sections located far remote from their source of raw materials. Fifty new homes are to be built at once in order to care for the skilled pottery employes who will come South.

At Johnson City and Erwin, Tenn., are located the plants of the Clinchfield Products Corporation. This company grinds feldspar and manufactures muriatic acid, barium carbonate, sodium sulphide, lithopone, blanc-fix and other chemicals.

At Kingsport, Tenn., the new chemical center of the South, is to be found the large plant of the Federal Dyestuff & Chemical Co. This company is now turning out large quantities of sulphur black, blue and yellow dyes, along with other chemicals. The Kingsport Extract Corporation is producing large quantities of tannin and tannic acid extract, and will use a large proportion of the extract at the tannery the corporation is now completing. The Kingsport Pulp Corporation has its large pulp plant well on the road to completion. The Clinchfield Portland Cement Corporation is installing a large lime and hydrating plant. They are also contemplating the installation of the Cottrell process for the recovery of potash. The Kingsport Brick Corporation recently increased their production of bricks by 25 per cent., and are now prepared to manufacture terra-cotta tile. All of these plants were located on the Clinchfield to take advantage of the readily available raw materials necessary for the production of their various commodities.

The territory served by the Clinchfield is rich in iron ores that bid fair to come into their own in the not distant future. The deposits in this section represent various types of ore, all of which are commercially available.

The manganese ore deposits represent bodies of considerable magnitude and importance, and are the source of another raw material that can be assembled and refined at a profit.

The zinc ores include the varieties smithsonite, calamine and sphalerite, which are the carbonate silicate and sulphide, respectively. These ores occur in various places in large quantities, and are being mined and concentrated on a large scale. Other zinc mines are expected to be opened up soon.

Other metallic minerals that occur in this district in greater or less quantity are chromite, stannite, rutile, monazite, columbite, samarksite, uraninite and low-grade nickel ores in large quantities.

A certain number of semi-precious gems are found, such as garnets, acquamarines, amethysts, topaz, moonstones, emerald, hiddinite, rhodolite, cyanite, sapphires and tourmaline.

In the igneous rock section of North Carolina tributary to the Clinchfield are large workable deposits of mass fiber asbestos, suitable for the production of lagging materials, asbestos roofing shingles, wall and pipe coverings, and for use in paints, etc.

The micas in this section are known the country over, both for their exceptional quality and as coming from the largest producing center in this country. The mica industry is one of great importance, the various grades of mica finding unique uses in many lines of trade. The larger sheets of mica are used for pattern and electric mica, the smaller pieces being used for "punch" mica and for grinding purposes. The wet-ground mica finds extensive application in the decoration of wallpaper and for lubricating purposes. The dry-ground mica is used extensively by roofing manufacturers, by automobile tire manufacturers, and as a foundry facing. Recently black mica, the variety biotite, has come into the market for use as a stone facing, that is, to give a granite effect to concrete blocks. Certain grades of dry-ground black mica are well adapted for use by the roofing trade, by the automobile trade, for foundry facings, and when heated under proper conditions it can be made to take on certain gold and bronze colors, which renders it suitable for certain decorating purposes and for use in the preparation of so-called bronze paints.

Soapstone and talc occur at various places in the crystalline belt, and offer material suitable for the manufacture of laundry tubs, laboratory sinks, laboratory table tops, switchboards, furnace linings and crayons. When ground it is suitable for foundry facings, roofing purposes, for use in paints, etc.

The graphite deposits of this section represent a commodity of considerable value. Since the outbreak of the European war the American deposits are being worked to an advantage. Graphite, as is well known, furnishes the basis of certain lubricants, crucibles, crayons, paints, etc.

In addition to the paint materials enumerated above, the ochers, umbers and siennas are important materials in the manufacture of paint pigments. Deposits of these are to be found at several places in the Clinchfield territory.

The salt, gypsum and barytes are minerals, the importance of which are well known. Salt is the basis of the manufacture of a number of heavy chemicals, such as soda ash, caustic soda, baking soda, chlorine, bleach and others.

Gypsum is used to a very large extent in Portland cement for the purpose of controlling the setting time. It is also used in wall plaster, for the production of plaster of Paris, as land plaster, and in certain cements other than Portland cement.

Barytes finds its widest application in the production of blanc-fix, lithopone, and the various barium compounds. It is used less extensively as a filler for paper and leather.

Large bodies of bauxite and bauxitic clays are known to occur in certain places in East Tennessee. These minerals are used in the production of the various aluminum salts and for the manufacture of aluminum.

Corundum and garnet deposits in the igneous rock territory can be used for making abrasives. These materials are being used to a large extent, and in some sections of the country represent quite important industries. They should be developed in this section.

From this list of available raw materials, high-grade fuels at low prices, good transportation facilities, an ample supply of native white labor, it is readily seen that this section of the South is destined to develop in an industrial way on a very large scale.

The agricultural resources on the Clinchfield are varied and many, and the climate is such as to permit of growing many kinds of crops at different places on the line. The valleys of Virginia and Tennessee are well adapted to the growing of grains, grasses and other staple crops and to stock-raising. In North Carolina conditions are especially adapted to horticulture, poultry-raising and trucking. In South Carolina conditions are favorable for trucking and cotton-growing. In connection with the agricultural resources, one naturally thinks of fertilizing materials. The limestones, feldspars and phosphate rock are the raw materials that constitute the basis of a number of preparatory fertilizers. These raw materials occur in large bodies in the Southern Appalachian territory.

V. V. Kelsay

Grave Danger in Present Centralization of Plants.

J. G. SCRUGHAM, Associate Member U. S. Naval Consulting Board, Reno, Nev.

IF States like New York, Pennsylvania, Massachusetts and Connecticut were in the hands of an invading power, under present conditions the industrial strength of the nation would be reduced approximately one-half. The reason for such centralization no longer exists, as the Southern and Western States are developing those economic factors which make for successful industries.

There has recently been introduced in the United States Senate by Senator Newlands a measure designed to create an engineering or industrial experiment station in every State of the Union. Such experiment stations will be of special benefit to the Southern States in the development of their technical industries, and the bill should receive the active support of every Southern interest. It is modeled along the lines of the State Agricultural Experiment Stations, which have been so successful, and is specifically designed to assist the full utilization of our undeveloped resources, of which the South has such an abundant supply.

Mellon's Institute of Industrial Research Should Stimulate South to Establish Similar Institutions.

By Raymond F. Bacon, Ph.D., Director.

WHEREVER raw materials are secured, or wherever they are made into goods to supply the many wants of man, there is a variety of problems awaiting solution. These may have to do with difficulties in manufacture, with the utilization of wastes, with the improving and cheapening of manufactured products, with finding new uses for products, or with the discovery of new and useful products. To aid industrialists in solving these problems by bringing the wealth of contemporary science to bear upon them, the Mellon Institute was founded. This institute represents an alliance between industry and learning, the possibilities of which may be said to be without limit.

RAYMOND F. BACON, Ph.D.

The alliance takes the form of what is known as "The Industrial Fellowship System." According to this system, a company, an association or an individual may contribute a definite sum of money to the Mellon Institute for a period of one or more years. This money—with the exception of a small sum for the purchase, if necessary, of very special apparatus—is used by the institute to pay the salary of the man or men who work on a particular problem, the solution of which is of interest to the donor. The institute houses the research, furnishes it with all ordinary supplies and apparatus, affords library and consultative facilities, gives careful direction to the progress of the work and offers an atmosphere sympathetic to research. The research is surrounded with the necessary secrecy, and any and all results obtained during the course of the fellowship belong exclusively to the donor thereof.

HISTORY OF THE INDUSTRIAL FELLOWSHIP SYSTEM.

The idea of this system of practical co-operation between science and industry was formulated by Robert Kennedy Duncan, the late director of the Mellon Institute, in 1906, while attending the Sixth International Congress of Applied Chemistry in Rome.

For some years previous to this congress Dr. Duncan had been in Europe gathering material for two of his books, "The New Knowledge" and "The Chemistry of Commerce." Through visits of inspection to the factories, laboratories and universities of some of the countries of Europe, and through conversations with industrialists and scientists, he had become impressed with the spirit of co-operation which existed between industry and learning, which made for the advancement of both. At the same time he became aware, more than ever before, of the fact that much of American industry, from the standpoint of manufacturing efficiency, was in a lamentable state. The absence of the application of modern science was one reason for this condition.

To remedy this it occurred to Dr. Duncan to propose an industrial fellowship system. Upon his return from Europe to accept the chair of industrial chemistry in the University of Kansas, he established there the first industrial fellowship, in January, 1907. The scheme was presented to the public by Dr. Duncan in an article entitled "Temporary Industrial Fellowships," in the North American Review for May, 1909, and a little later in the last chapter of his book on "The Chemistry of Commerce."

In 1911 Dr. Duncan was called to the University of Pittsburgh to inaugurate the system in the Department of Industrial Research, and the working of the fellowships began in a temporary building erected at a cost of about $10,000. In March, 1913, Messrs. Andrew William Mellon and Richard Beatty Mellon, citizens of Pittsburgh and sons of the late Judge Thomas Mellon of the class of 1837 at the University of Pittsburgh, impressed by the practical value of the system both to industry and to learning, established it on a permanent basis.* While the institute is an integral part of the University of Pittsburgh and works in close sympathetic accord with it, it possesses an endowment of its own and is under its own management. It is important to note here that the Mellon Institute is not in any sense of the word of a commercial nature.

When the industrial fellowship system passed out of its experimental stage—when the Mellon Institute moved into its permanent home in February, 1915—23 fellowships were in operation. At the present time (August 15, 1916) there are 40 fellowships, and two additional ones have recently been arranged for, to begin later in the year. The growth of the institute has about reached the stage where we shall be obliged to decline further industrial investigations for the present, since our laboratories are almost filled up to capacity.

SERVICES OF PUBLIC INTEREST RENDERED BY THE MELLON INSTITUTE.

The services of public interest rendered by the Mellon Institute may be regarded as of ten distinct types, which may be conveniently summarized as follows:

(1). The Mellon Institute has provided for American manufacturers favorable opportunities for productive industrial research. It has, in this way, secured for competent investigators conducive facilities for conducting industrially important researches.

The many distinguished scientists and prominent industrialists who have inspected the new $350,000 building of the institute are enthusiastic in their commendation of its design, equipment and facilities for research; it is, in fact, regarded generally as one of the most modern industrial problem workshops in the United States, if not the world.

(2). Because of the practical system of co-operation between science and industry in operation at the Mellon Institute, this institution has been able to find and support brilliant researchers—trained men who work for the exercise of the investigative instinct and for the pleasure of overcoming difficulties. The Mellon Institute has done this because of the extraordinary economic importance of new ideas in manufacturing.

(3). The Mellon Institute constantly maintains a familiarity with the general progress in science and technology and has established an acquaintance not only with those fields of industry which have been investigated, but also with the problems which engage the attention of the manufacturers of today.

These accomplishments constitute the actual basis of the institute's largest field of public service, namely, the effective co-operation with manufacturers who are confronted with problems which require study.

During the five years which have elapsed since the establishment of the first industrial fellowship at the Mellon Institute 47 distinct business organizations have endowed some 105 one-year fellowships. They have done this in the belief that the Mellon Institute was in a position to mobilize and concentrate all of the advantages and opportunities known to science for the solution of their particular problems.

The total amount of money contributed to the Mellon Institute by American manufacturers for the five years ending March 1, 1916, was $360,400. In addition to this sum of money, $21,300 were awarded in bonuses to fellows (industrial researchers) for the successful solution of manufacturing problems.

During the five years the institute itself expended about $175,000 in taking care of the overhead expenses in connection with the operation of the industrial fellowships. Besides this amount of money, the building and permanent equipment of the institute represent an investment of about $350,000.

That the results obtained under the industrial fellowship system of the Mellon Institute have justified the expenditures of these sums of money, both on the part of industrial concerns and the institute itself, has been shown by the fact that during the first four years—March, 1911, to March, 1915—seven out of every ten problems assigned to the institute for study were solved to the satisfaction of the donors. A large percentage of the industrial fellowships were renewed, showing the confidence which American manufacturers have in the institute.

Twenty-five patents have been granted to the holders of industrial fellowships, and there are as many more pending. Then, too, some 20 new processes have been developed in the institute, and all of these are now in actual operation on commercial scales.

The following table shows the number of industrial fellowships that have been founded from March to March of each year, 1911-1916; the number of investigators or fellows, as they are called, who have been employed on these fellowships, and the total amounts of money contributed for their maintenance by industrial concerns:

March to March.	No. of industrial fellowships.	No. of fellows.	Amounts contributed.
1911-1912	11	24	$39,700
1912-1913	16	30	54,300
1913-1914	21	37	78,400
1914-1915	21	32	61,200
1915-1916	36	63	126,800

(4.) The Mellon Institute secures through proper connections systematic, prompt advice of all developments in American and European industrial practice, and its industrial service bureau gives especial attention to inquiries relating to industrial economics and to the application of scientific methods to manufacturing. Numerous requests for information are received during

*On February 18, 1914, the Institute lost by death its founder and director, Dr. Robert Kennedy Duncan. Dr. Duncan was succeeded by the writer, who had been associate director.

RAYMOND F. BACON, Ph. D., director of Mellon Institute of Industrial Research and School of Specific Industries, also dean of School of Chemistry, University of Pittsburgh. Graduated from De Pauw University, 1899, with degree of B. S.; 1899-1900, instructor at De Pauw; 1900, received degree of M. A. from De Pauw; 1900-1901, professor of chemistry at Vincennes University; 1900-1904, held a fellowship in chemistry at the University of Chicago; 1904, received degree of Ph. D. at the University of Chicago; 1905-1910, chemist in the United States Bureau of Science, Manila, P. I., contributing then numerous papers on the chemistry and technology of essential oils and on the economic possibilities of the Philippines, mostly to the *Philippine Journal of Science;* 1910-1911, engaged in research in Bureau of Chemistry, Washington, D. C.; September, 1911, left Government service to become senior fellow on Petroleum Fellowship in Department of Industrial Research of University of Pittsburgh. Inventor of processes now in successful commercial operation for manufacture of gasoline, recovery of cuprous sulphide from ores, and for hydrogenation of cottonseed oil. Chairman of the Naval Advisory Board of the State of Pennsylvania.

every month from American business men and industrial establishments; and, in keeping with its abiding attitude of welcome toward manufacturers in technical difficulties, the institute regards it as a privilege to render the service asked for.

(5). It is well known that the national trait of desiring good returns for a minimum expenditure of money has fostered certain empirical work which has gone under the garb of industrial research and is even now the predominant principle in many of the so-called research departments of our industrial plants. Its history shows that the system in operation at the Mellon Institute constitutes a tried method of combating pseudo-research in industry, for the cost factor is reduced to a minimum by the endowment of the institute.

(6). The Mellon Institute has played an active part in educating the public to the realizable functions of research and in imparting to the popular mind a wider recognition of the lines of demarcation which distinguish original investigation from other worthy objects. Hand in hand with this campaign of publicity for the betterment of American industry has been the activity of the Mellon Institute in establishing an acquaintance on the part of American manufacturers with the investigational power and activities of American research chemists. Since the Mellon Institute is the only endowed industrial research institution in the country, it has been in a very favorable position for contributing to the education of the American public to the value of research.

The Mellon Institute has during the past two years contributed 12 different papers on research, its value and methods, to the scientific journals. Reprints of these contributions have been freely disseminated and widely read.

(7). The Mellon Institute has promoted the progress of science and industry and has stimulated further scientific inquiry by making available to the workers in science and technology complete and detailed accounts of what has been accomplished in its research laboratories.

The agreements under which industrial fellowships are founded provide for the eventual publication of the results obtained. But this can be done only at such time as will not unduly injure the interests of the donating companies. Since those who pay for the investigations own the results, much of the important work done at the institute to date has not yet been published. But, on the average, 10 reports of researches are contributed each year to the various chemical journals.

(8). The experience of the Mellon Institute in industrial research has been drawn upon heavily by a number of independent organizations which have recently entered this field. The administrative experience of the institute is always available for use by its prospective allies and the institute welcomes warmly their entrance into the field of industrial research. In keeping with this attitude, the Mellon Institute has established, wherever possible, stable relations with other organizations, both in this country and abroad. The following institutions have lately inaugurated industrial research departments based upon the system in operation at the Mellon Institute: The University of Kansas (Division of State Chemical Research), the Royal Canadian Institute (Bureau of Scientific and Industrial Research), and the Universities of Michigan and of Washington. The Georgia School of Technology, Massachusetts Agricultural College, Syracuse University and Columbia University are contemplating similar steps in this country, and the University of Sheffield and the Sir John Cass Technical Institute, in London, England, have the adoption of the system under advisement. Then, too, the Federal Government of Australia and the Japanese Government are investigating the possibilities of establishing institutions of the type of the Mellon Institute.

The Mellon Institute contends that no greater good to society can arise than from a wider distribution of the duties and responsibilities of research. Accordingly, it has co-operated with the above-mentioned institutions and has rendered the informative service necessary for the establishment and organization of their industrial research laboratories.

(9). It has contributed to education by providing the nuclei for the Schools of Chemistry and Specific Industries and for the Department of Chemical Engineering of the University of Pittsburgh.

The staff of instruction of the School of Chemistry of the University of Pittsburgh includes the regular faculty of the university and industrial fellows from the Mellon Institute who are especially qualified in various technical and theoretical branches. This happy combination gives the school of chemistry the unique opportunity to offer not only the customary undergraduate and graduate courses, but also specialized work under men who possess eminent qualifications in their particular branches and are in close touch with prevailing industrial practice.

The new home of the Mellon Institute affords ample accommodation for a graduate school of specific industries. This educational innovation, in operation only since the dedication of the permanent building of the institute, has so favorably impressed certain manufacturers that they have made arrangements for training a number of young chemists to become experts in specific branches of technology. The plan of this graduate school of specific industries obviates the dangers incidental to early specialization during the period of training, and it thus overcomes one of the principal difficulties of the past. It has been predicted that schools of this type can only result in a more satisfactory correlation of the work of the chemist and engineer in industry, and, by providing a sounder professional training, render the university of greater service to industry.

(10). The Mellon Institute maintains a department of research in pure chemistry, wherein graduates of colleges in good standing may be admitted as candidates for advanced degrees. It is the principal duty of the head of this department, Dr. Martin A. Rosanoff, the incumbent of the Willard Gibbs professorship of research in pure chemistry, to maintain in it the highest attainable academic standard.

Six fellowships in pure chemistry are available to those who desire to pursue graduate study in pure chemistry.

The national service which the Mellon Institute is now rendering has been alluded to as follows by Dr. Marston Taylor Bogert, professor of organic chemistry in Columbia University, New York (Science, n. s., 42, 737):

"Our own country is beginning to awaken to the fact that civilization unarmed by science is at a terrible disadvantage in the event of a struggle for existence, and that this arming cannot be done at short notice. The result is a loud and urgent call upon the universities, colleges and technical schools of the land for help.

"Conspicuous among those answering this call most effectively are the University of Pittsburgh and its Mellon Institute. Conducting an energetic campaign for the education of the community to a better appreciation of science, pointing out to the manufacturers wherein the chemist can aid them, and winning their support for chemical research, prosecuting skillful investigations directed to the immediate public needs, and turning out highly trained scientists, this university has already made an enviable record of service, and has placed under a lasting debt of gratitude not only the city of Pittsburgh, the chemical profession and the nation, but the entire world of humanity as well, for its activities minister in the highest degree to the progress of civilization and its achievements ultimately become the property of all mankind."

R. F. Bacon

Everything in Raw Material Needed for National Preparedness Found in Abundance in South.

JOHN STEPHEN SEWELL, Alabama Marble Co., Gantts Quarry, Ala.

THE further development of the steel industry and of the chemical industries in the South is of the greatest importance to the nation as a whole, for the reason that the localities where the raw materials for such development are most easily available are admirably located from a military and strategic point of view.

Speaking in terms of undeveloped, or partially developed, resources, that portion of the South centering around Birmingham, Ala., contains in adequate quantities all of the coal, iron ore, cotton, water power and sources of sulphuric and nitric acid required to supply the entire country with munitions in the event of a great war without assistance from any other portion of the country at all. What is needed is adequate development.

That an increase in industrial development in any section of the country is of benefit to the entire nation cannot be doubted. It increases the purchasing power of the section of country concerned for all of the products which must be produced elsewhere. To the extent that an export trade is developed, it has, of course, a favorable influence on foreign trade conditions and our trade balance.

If the South's chemical resources are adequately developed it will cheapen the cost of fertilizers and increase the productiveness of the soil. An adequate supply of dyestuffs locally produced ought to have a favorable influence upon the textile industries and ultimately bring about a state of affairs where, with the assistance of mills in the North, a much greater portion of the South's cotton crop would be sold in finished form, ready for use by the consumer.

The development of a highly-paid industrial population is one of the surest means of accumulating capital, and accumulated capital, wherever produced, must be of benefit to the entire nation. That such development will work wonders for the South itself is axiomatic.

It is in a military sense, however, that the development of the chemical resources of the South is of the most importance to the nation as a whole. Everything in the way of raw material that is required in considerable quantities is here in adequate amount. All that is required is development. With these materials and the industries for using them adequately developed in the South, the country will be secure, so far as its supply of munitions is concerned, no matter what may happen; the economic results that will surely follow the development are in themselves a sufficient justification for undertaking it. Its military importance makes it really imperative and removes its desirability from the domain of debatable questions.

It seems to the writer that if the Government could be induced to establish a small arsenal somewhere within reach of the Birmingham ores, the concerns now interested in the steel and iron business in Birmingham and its vicinity would readily undertake to produce steel of the proper quality. With a beginning of this sort by the Government there would be created a nucleus of highly skilled operatives, and the necessary manufacturing atmosphere would be created favorable to the further development of the same or allied industries. This would result within a comparatively short time in a population able to furnish the requisite skill for the production of munitions on any desired scale.

The beneficent effect of the establishment of the chemical industries in the South upon agriculture, or on the textile industries and other business, seems too obvious to require any further discussion.

Relation of Chemistry to the Cottonseed-Oil Industry.

By David Wesson, Manager Technical Department, Southern Cotton Oil Co.

THE wonderful growth of the cottonseed-oil industry in this country is a beautiful example of the aid given by applied chemistry in producing a large number of valuable products from a material which was at one time regarded as a nuisance. It was not so many years ago that laws were passed in some of the States making it a punishable offense to throw cottonseed into the rivers.

DAVID WESSON.

In the "Statistics of South Carolina," published 1826, the statement is made that "Dr. Benjamin Waring established the first paper, oil and grist mills at Columbia, S. C., and expressed from cottonseed a very good oil."

Georgia had an oil mill in 1832, but little is known of its history.

C. D. Arfwedson, Esq., in his book entitled "United States and Canada, 1832, 1833 and 1834," under the heading "Cotton Culture," makes the following mention of cottonseed:

"In many places it is usual to manure the fields with the seed not used for planting, but of late years experience has taught the planters to set a higher price on it, as it contains a considerable quantity of oil, which is extracted by pressure and is suitable both for burning and painting. The oil may in the course of years become an additional source of wealth to the planters."

Today this conjecture is more than realized. The growth of the industry can be best illustrated by comparing a few statistics relating to its early years with those of the last few years. The commercial importance of the industry had its beginning from 1850 to 1855, and was just commencing to attract attention when it was interrupted by the Civil War. The only available statistics begin in 1872. The following table will give an idea of the growth of the industry from 1872 to 1890:

Year ending June 30,	Seed produced. Tons.	Seed worked. Tons.	Values.	Per cent. crop worked.
1872	.....	52,705	.....	4
1874	1,687,000	84,000	$2,530,000	5
1875	2,057,000	123,000	3,970,000	6
1876	1,969,000	98,000	2,610,000	5
1877	2,148,000	150,000	3,910,000	7
1878	2,268,000	181,000	3,810,000	8
1879	2,616,000	235,000	5,640,000	9
1880	3,039,000	182,000	4,610,000	6
1881	2,455,000	295,000	8,380,000	12
1882	3,266,000	392,000	10,640,000	12
1883	2,639,000	396,000	9,850,000	15
1884	2,625,000	499,000	10,470,000	19
1885	3,045,000	578,000	10,970,000	19
1886	3,018,000	694,000	12,820,000	23
1887	3,291,000	823,000	17,130,000	25
1888	3,310,000	794,000	20,370,000	24
1889	3,495,000	874,000	16,400,000	25
1890	4,093,000	1,023,000	19,790,000	25

For comparison we have the cottonseed crushed in the last four years:

Year ending June 30,	Seed produced. Tons.	Seed worked. Tons.	Values.	Per cent. crop worked.
1912	6,104,000	4,179,508	$132,230,000	73
1913	6,305,000	4,767,802	155,500,000	75
1914	7,500,000	5,493,899	145,000,000	74
1915	5,500,000	4,132,466	192,500,000	75

Putting the matter in another way, the value of

Seed crushed in 1874 was	$2,530,000
Seed crushed in 1915 was	192,500,000

The number of establishments in the early years of the industry were as follows:

Year.	Factories.	Workers.
1860	7	183
1870	26	644
1875	35	2,124
1880	45	3,114
1885	80	4,900
1890	119	6,301
1895	250	....
1900	357	....
1905	715	....

The number of establishments crushing the seed the last four years are:

Year.	Factories.	Workers.
1912	857	17,500
1913	870	....
1914	880	....
1915	840	*20,000
1915, officers and other salaried men	...	5,000

*Estimated.

DAVID WESSON was born in Brooklyn, N. Y., 1861. Graduated from Public School No. 11, 1877. Attended Brooklyn Polytechnic, 1877 to 1878; graduated from the Massachusetts Institute of Technology, 1883, with S.B. in chemistry; 1883-1884, assistant to Prof. Wm. Ripley Nichols; 1884-1890, chemist for N. K. Fairbank Co., Chicago; 1890-1895, chief chemist American Cotton Oil Co. at Guttenburg plant; 1895-1899, president Wesson Manufacturing Co., Cortland, N. Y.; 1890-1903, general manager Wesson Process Co. and chemist with Southern Cotton Oil Co.; 1903 to date, manager Technical Department Southern Cotton Oil Co. Charter member American Institute of Chemical Engineers and Society of Cotton Products Analysts, of which he was the second president; member American Chemical Society, Society Chemical Industry, Electro Chemical Society, American Association for Advancement of Science, Chemists' Club, Technology Club of New York, Montclair Club and Sons of the American Revolution.

The causes of the enormous growth of the industry are various:

First—There has been a rapid increase in the population of this country as well as many of the other countries of the civilized world, calling for an increased supply of food materials. In the early days of this country, when meat was plentiful and the hog production large, lard was the chief cooking fat in America and northern Europe. With the doing away of the large cattle ranches in our Western States and the increased demand for meat food products, more and more of the hog has been eaten as pork, while there has been less lard to supply the demands for edible fat. This demand is being largely supplied in the present day by cottonseed oil, and the growth of the cottonseed-oil industry has been more or less coincident with the decrease per capita supply of hog lard.

Second—Cottonseed oil produced in the early days of the industry was a very irregular product. It commenced to be used about 1879 in small quantities to adulterate hog lard. The result was not an improvement to the mixture. Frequent attempts were made to improve the quality of the oil, but owing to the great differences in the character of the raw material, due to seasonal influence on the seed, the results did not meet with grat success. It was about this time that chemistry commenced to be applied to the industry, which has been growing by leaps and bounds ever since.

The first efforts of the chemist were devoted to refining the oil. He began to test the crude oil delivered by the mills to see how much of a yield of the refined oil it would produce and what quality of refined oil he could make from it. He next began to try to improve refining and bleaching methods. It was not until 1887, after the formation of the American Cotton Oil Co., that any organized effort was made to examine mill products with a view to finding out how much oil was left behind in the cake and what were the losses taking place in the hulls.

It would seem that a logical presentation of our subject should first take up the development of the work of the mills and their products, of which oil is the principal one, and then take up the work of the chemist as applied to the oil.

In the early days of the industry it was the practice to try to produce a very handsome appearing crude oil and beautiful, soft, golden yellow cake and meal. Apparently little attention was paid to the matter of yields. The mills producing crude oil were called "crude mills," and the word "crude" described them very well. The hulls were burned under the boilers, and the hull ashes were sold as fertilizer. The crude oil was shipped in all kinds of barrels, from new oak barrels to whiskey and varnish barrels. In fact, the writer remembers one instance where a barrel of whiskey was accidentally dumped with a carload of barrels of cottonseed oil which were being emptied into a lard refinery, to the great grief of the workmen, who made the discovery too late. The refiner was at considerable loss to get the flavor of the whiskey out of the oil afterwards.

In the year 1887 the writer established a small laboratory in Chicago for the analysis of products from the mills of the American Cotton Oil Co. Some of the results of the analytical work showed on 244 samples of cake an average oil contents of 13.55 per cent., while on 226 samples of meal the average oil contents was 12.18. per cent. Hulls were not analyzed at this time, except they were generally inspected, and if they showed a considerable proportion of uncut seed or meats, attention was directed to the mill manager.

The American Fertilizer Handbook publishes some interesting articles by Thos. C. Law of Atlanta, Ga., wherein he shows analyses of meal for the last five years. For the crushing season just ended, 1915-1916, the average oil contents of over 13,000 samples of meal was 6.38 per cent.

The comparative yields of products per ton of seed for the years 1888 and 1916 are shown in the following table. The improvement will be noted at a glance:

	1888.	1916.	Increase. Per cent.	Decrease. Per cent.
Cake and meal	750	1,041	39.	..
Oil	290	321	10.7	..
Hulls	750	377	..	50.
Linters	22	125	470.	..
Miscellaneous	..	8	..	..
Loss	188	128	..	32.
	2,000	2,000		

These results have been brought about by the chemist making innumerable analyses of the seed, demonstrating the amount of oil and meal contents therein, and then by making constant analyses of the mill products he has enabled the managers to keep a close physical audit on the work of the mills, keeping the mechanical department constantly striving to attain the ideals pointed out by the results of the analytical work.

Whether it was the results of the numerous analyses made by the chemists at the Agricultural Experiment Stations which demonstrated the feeding value of cottonseed hulls, or whether it was the animal instinct of the cows themselves, the fact remains that in 1888 the hulls which were considered to have a fuel value equivalent to two pounds of hulls to one pound of soft coal have for the last few years been selling at prices ranging from $5 to $10 a ton.

The great increase in the production of linters has been due to the heavy demand for guncotton and its products, caused by the present war. This increase is therefore directly due to the necessity for raw material in a strictly chemical industry. Linters are also used in mattresses, furniture cushions, absorbent cotton and batting.

The greatest work of the chemist in bringing the cotton oil industry to its present state of development has been along the lines of refining the oil. In

the early days of the industry the product of the oil mills was known as prime or off crude oil, and was sold principally on taste and appearance. Along in 1890 the writer made it a practice to govern purchases by the percentage of free acid found in the oil, taking the same as the index of the fermentation which the seed had undergone prior to the pressing of the oil. The lower the free acid, the better the oil. This innovation aroused considerable opposition from the brokers and the oil mill men, some of whom strenuously protested that no free fatty acid had ever come on their premises, and therefore could not be found in their oil. The amount of free acid present afterwards became naturally an index for the proper amount of alkali to be used in refining, and by careful selection of the crude oil considerable improvement was made in the ordinary yellow oils of that early period.

Refining methods consisted simply of the addition of caustic soda to the crude oil in sufficient quantity to produce the desired color. Different refiners used different methods of determining the proper amount, the chief method being what chemists would call "guessometric." One man, remembered by the writer, used to tell the strength of his lye by rubbing a few drops between his fingers.

The oil was finished in different ways, many concerns heating the oil and blowing it with compressed air after the soap-stock had been settled in another tank. Another favorite method of removing the moisture was to heat the oil in shallow, flat tanks until the moisture was expelled. One concern, noted for its olive-flavored oil, used to obtain the same by heating the oil to a temperature considerably above the boiling point of water in shallow tanks under the skylights. This improved the color of the oil, and, there being no accounting for tastes, may have improved the flavor, according to the light of those days. At any rate, the oil was turned rancid.

Winter oil, or oil from which the stearine was removed, was made by chilling the oil in barrels or other containers in cellars by the use of large quantities of ice. The oil was then pressed in ordinary hand presses, removing the stearine and making the so-called winter and salad oils. This has been changed by the use of ice machines and improved presses.

The first white oils were made by the use of bichromate or permanganate of potash and sulphuric acid. Only a small percentage of these oils were used in lard mixtures on account of their rank flavor, and they were not made in any great quantities, except for us in miners' lamps, where the oil found ready sale.

About the year 1880 fullers earth was first used, and ever since this has been the standard method of removing the yellow color from alkali refined oils. The operation is very simple, the earth being agitated with the oil at the proper temperature—in the neighborhood of 100° C.—and then passing the oil through a filter press to remove the earth. The resultant oil is nearly white in color, but possesses, however, a distinctive earthly flavor. Owing to careful chemical control, the quality of the earth used for this purpose has been greatly improved, while the quantity has been greatly diminished, so the actual loss in the bleaching operation has been made nearly negligible.

About 1891 a marked improvement was made by the introduction of a deordorizing process which consisted of blowing steam through the oil heated at a temperature considerably above the boiling point of water. This carried off a great deal of the odor and flavor and made the oil much superior for use in lard compounds. The oil prepared in this manner, though still containing considerable flavor, did not keep any too well, and while it added a great impetus to the consumption of the oil and the development of the lard compound industry, left much to be desired. The Wesson process, invented by the writer in 1900 and rapidly developed into a practical commercial proposition, brought about a marked revolution in the oil and lard compound businesses. This new process produced an oil of superior color, free from odor and flavor, and one which gave off very little objectionable odor when used in cooking. The oil produced by this process bore the same relation to the ordinary summer yellow oil of commerce as does granulated sugar to the low grades of yellow and brown sugars which enter the sugar refineries. One of the immediate effects of this process was a stimulation of the demand for cottonseed oil for margarine in Europe, as it set a new fashion in so-called butter oil, and the brands sold under this process immediately acquired a supremacy. In fact, it became so popular that very successful factories using the process were established in England and Germany before the outbreak of the war now devastating Europe.

It seemed for several years as though the limit had been nearly reached in the development of food products from the oil. The compound lard industry, which had been growing steadily from 1880 to 1911, was able to make a satisfactory product with about 15 per cent. of oleostearine, a by-product of the oleomargarine industry, mixed with 85 per cent. of highly refined cottonseed oil. The ideal of fat chemists, however, was to produce a satisfactory lard compound containing no animal fat whatever. This was brought to pass about 1911 through the invention of the process generally known as hydrogenation. The French chemists, Sabattier and Senderens, discovered that certain unsaturated organic compounds, such, for instance, as oleic acid, when brought in contact under proper conditions with finely divided nickel in the presence of a current of hydrogen were converted into saturated compounds. This principle about 1911 was successfully applied to converting the fluid portions of various fats and oils, among them cottonseed, to solid fats. The chief difference between the fluid portion of cottonseed oil and a hard fat is 1 per cent. of hydrogen. This is added by heating the oil in the presence of a catalyser, generally nickel, in a stream of pure hydrogen gas. According to the amount of treatment, the oil may be hardened to the consistency of butter, lard, tallow or stearic acid. It may have a melting point varying from 30 to 63° C. The harder material can be used in lard compounds in the same manner as oleostearine, while a softer material is well known throughout the country under the much advertised name of Crisco.

No article dealing with the chemical development of an industry can overlook the matter of by-products. In refining the oil, varying amounts of a material known as soap-stock are produced. In the early days of the industry the losses were enormous, 12 to 14 per cent. being not an unusual average, while at the present day losses do not exceed 9 per cent. for the average work of a well-regulated plant. Soap-stock contains, besides the fatty acids neutralized in the process of refining, considerable quantities of coloring matter and free oil. In the early days soap-stock was boiled up with caustic soda and salt and converted into a yellow soap much used by the woolen manufacturers. This was rather a soft soap, and by mixing proper quantities of tallow and rosin was converted into a low-grade of laundry soap by many manufacturers. About 1887 it was worked into washing powder, and the "Gold Dust Twins" have been working hard at it ever since.

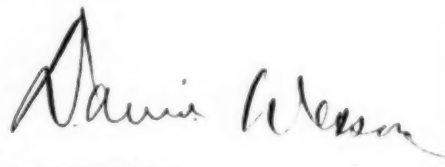
About 1900 it was found possible to recover the glycerine existing in the soap-stock and to distill the fatty acids resulting from saponification. This was brought about largely through the work of Ernest Twitchell of Cincinnati. At the present time, owing to the large demands of the war for glycerine, most of the soap-stock is saponified so as to recover the glycerine, and the resultant fatty acids, by means of distillation, are converted into a very light-colored product, which forms the basis of some of the most popular laundry soaps.

In the distillation of the fatty acids a resinous pitch remains as a residue, which is used largely in paints and roofing materials. The chemist has not finished with this product, and hopes to make something better as time goes on.

In conclusion it may be said that at the present time an oil mill can operate about as successfully without a chemist as an ocean liner can cross the Atlantic without a navigating officer. The oil mill manager needs a chemist as much as he needs his bookkeeper and mill superintendent if he is going to run his business on an efficiency basis. In the refining of the oil and the manufacturing of lard subsitutes and other edible products therefrom, the attention of the chemist is needed at every step to pass upon the accuracy of the work and to maintain the quality of the products. In the work of catalysis or hydrogenation the chemist ranks supreme in producing results. The same may be said in handling the by-products, as the manufacture of fatty acids and glycerine from the soap-stock is a strictly chemical problem, and needs close technical supervision.

Another by-product to which attention should be called is the manufacture of hull fiber from hulls and conversion of the same into cellulose. This depends also for success on the work of the chemist.

We can safely say that were it not for applied chemistry the farmer would not be receiving about $192,000,000 a year for his seed, the world would not be receiving 4,000,000 barrels a year of edible oil, nor the excellent cooking fats free from all animal associations produced from it. We would be short a great many thousand pounds of first-class soap-making material and roofing pitch, all of which benefit the human race, while the cattle of the world would greatly miss the annual production of 1,500,000 to 2,000,000 tons of cake and meal and over 1,000,000 tons of cottonseed hulls.



Importance of Alkali Works as an Element in National Preparedness.

W. D. Mount, General Manager the Mathieson Alkali Works, Saltville, Va.

THE location of the Mathieson Alkali Works at Saltville, in the mountain region of Southwestern Virginia, is very favorable to continued production of alkali in case of war. It is far from any national boundary, and would only be accessible to an enemy after long-protracted, successful, aggressive struggle.

The salt supply is ample for an indefinite period; the coal supply is from nearby fields; limestone is abundant locally, and ammonia, now received from outside points, bids fair to become a local product.

This company has been in regular and continuous operation for 21 years producing soda ash, caustic soda and bicarbonate of soda, together with other special alkali products. Although salt is not a product at present, it could be made and shipped in large quantities in case of need.

It is well known that caustic soda is necessary for preparing raw materials for manufacture of high explosives; in case of need the entire product of the works could be turned into caustic soda.

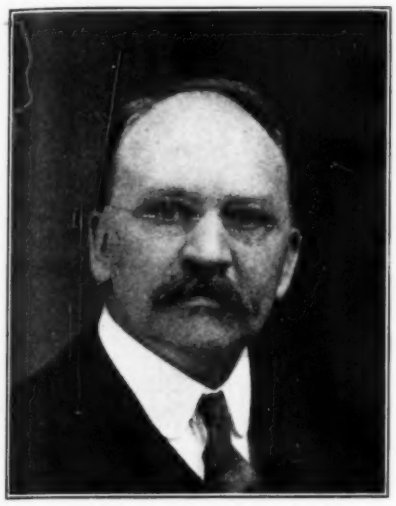
It is well known also that nitrogen is a necessary component of all explosives, and it is an important fact that an allied company is now carrying on experiments at Saltville, on patented processes, on a semi-commercial scale, whose object is the fixation of atmospheric nitrogen. These experiments show distinct signs of commercial success, and their importance in case of war needs no elaboration.

Enlargement of the machine shops and foundry planned for the near future could be applied to production of munitions in case of war, and further enlargements could be made at short notice. Saltville, with its present shipping facilities, is of great potential value as a protected source of a number of important items entering directly or indirectly into the manufacture of war material.

The Fertilizer Industry, Developed by Chemistry, and Its Relation to Agriculture.

By F. B. Carpenter, Richmond, Chief Chemist Virginia-Carolina Chemical Co.

CHEMICAL industry has been of tremendous assistance in the development of the vast hidden resources of this country, and this development in turn has wrought great changes in our industrial and social welfare. One of the striking examples of what the chemist has done for the benefit of mankind is the development of the fertilizer industries of the world, which enable the agriculturalist to maintain the fertility of the soil and thus supply sufficient food for the ever-increasing population. The beginning of the present century has witnessed a tremendous increase in the use of commercial fertilizers. In the year 1900 there were produced in the United States 2,200,000 tons, and in the year 1914 the production had increased to 7,631,203 tons, two-thirds of which were produced in the Southern States. This represents an outlay by the farmers of this country of more than $150,000,000.



F. B. CARPENTER.

No better testimonial could be given of the usefulness and value of a commodity than these significant figures showing this large increase in production in a comparatively short time. If, however, we study the real conditions of agriculture we wonder that the production and consumption have not been even greater. The amount of fertilizers used in different localities varies widely, according to conditions of fertility and kind of farming practiced, but it may be stated in a general way that the consumption is largest in those sections which have been the longest under cultivation; thus in many of the Eastern States large quantities are employed of necessity, while in the West farmers are only just beginning to learn that their application is necessary for the profitable production of crops.

The existence of the human race is dependent upon agriculture, which by the production of certain plants serves to feed, clothe or otherwise contribute to its welfare and happiness, and the history of the fertilizer business is a part of the record of what man has done to assist nature in the greater production of useful vegetation. Plants, like animals, must have an abundance of food if they are to be developed vigorously and thrive; fertilizers, therefore, serve a similar purpose in maintaining the life and growth of plants that food does in sustaining life and development in the animal kingdom. Fortunately nature has made a most abundant provision for the growth of a great variety of vegetation, but as civilization advances and population increases man is compelled to assist nature in order to supply himself with the vegetable products which his necessities or luxuries demand.

A century ago little was known concerning the nature of soils and their relation to plant growth. Some of the lands which had been producing bountiful crops were becoming less productive under the primitive methods practiced by the early agriculturalists. Scientists set to work to find a reason for this, and these early investigations laid the foundations for the vast amount of research work which has been and is being carried on at the present time in the interest of agriculture. The science of chemistry was just beginning to get on a firm foundation, and by the middle of the century chemists began to learn something of the real nature of the soil and its relation to plant growth.

Liebig, an eminent chemist, was the first to study the chemical composition of the ashes of plants and to point out the necessity of supplying plants with mineral foods; he conceived the idea of dissolving bones with sulphuric acid and thus render the phosphoric acid soluble, in which condition it could be more readily utilized by the growing plants. This, then, was the real beginning of the manufacture of fertilizers. It is true that it had long been known that certain substances increased the production of growing crops, but up to this time there had been no real scientific explanation of the beneficial effects thus produced. Liebig foresaw with wonderful accuracy that a great industry would grow out of his researches, as will be seen from a letter which was addressed to American farmers, a part of which was as follows:

"Manufacturers of manure will be established in which the farmer can obtain the most efficacious manure for all varieties of soils and plants. Then no artificial manure will be sold whose exact amount of efficacious elements is not known, and this amount will be the scale of determining its value. Instead of the uncertainty of mere empiricism, all the operations of agriculture will be carried on with certainty, and instead of awaiting the results of our labors with anxiety and doubt, our minds will be filled with patience and confidence."

Thus the great principles underlying the application of artificial fertilizers were fully set forth, and, as prophesied, have resulted in a large and growing industry.

The treatment of mineral phosphates with sulphuric acid, however, originated with Laws, who took out a patent for the process in 1842 and established a factory, from which time the commercial production really dates. During the first years the development was slow, but during the past thirty years there has been a steady growth, until at the present time the manufacture of fertilizers has reached enormous proportions in the eastern and southern parts of our country.

Chemistry has made many and varied contributions to industries allied to agriculture, but probably its most valuable achievements in the branch of agricultural chemistry are those which have developed the fertilizer industries of the world. Agriculture is really the foundation of all industry and wealth; any contribution, therefore, which has increased the production of the soil has indirectly benefited all avenues of trade and exerted a tremendous influence on our national welfare. If it were not for the chemist the enormous natural storehouses of plant food would still remain undeveloped; but as a result of his untiring researches, assisted by the miner and engineer, these valuable natural fertilizer constituents, which have accumulated through the ages in different parts of the world, have been utilized and converted into mixtures which make it possible to produce larger crops, made necessary by the ever-increasing population. Thus the large deposits of nitrate of soda in South America, the potash mines in Germany and the numerous natural accumulations of phosphates have been developed and their products converted by chemical treatment into valuable plant food compounds. In addition to these natural sources there have been collected "from the four corners of the earth" large quantities of refuse substances from various industries, which have by chemical treatment been converted into useful constituents for the manufacture of fertilizers. The very air we breathe is being utilized in producing nitrogen compounds in suitable form for plant nutrition, thus insuring an abundant supply of this element for all time. Nitrogen is one of the most important elements in plant production, and only a few years ago there was considerable apprehension lest its supply in combined form would not be sufficient to produce enough food for the rapidly increasing population. With this new discovery the future supply of combined nitrogen is assured, not only for agricultural purposes, but for other uses in which large quantities are employed. The utilization of the nitrogen of the air, and combining it in suitable form for industrial purposes at a reasonable cost, may be regarded as one of the most important of the recent achievements in industrial chemistry.

Some of the necessary ingredients of plant food are found in abundance in nearly all cultivated soils, but agricultural science has demonstrated that the supply of phosphoric acid, potash, nitrogen and sometimes lime is often insufficient originally, or becomes so by long-continued cultivation. Vegetation draws heavily of these compounds, and to counteract this continued drain most economically fertilizers are employed. A proper fertilizer must not only contain one or more of the essential constituents, but the compounds must be easily convertible by the action of rain and moisture to such a form that plants can readily absorb them. To properly prepare the various materials for plant food requires large factories and expensive equipment, where all the different substances are treated chemically or mechanically, according to their different requirements, and blended together in suitable proportion to meet the requirements of different soils and crops.

With the advent of the fertilizer industry agriculture began to take on a new lease of life, so to speak, and its influences are being felt more and more each year as the natural fertility of our lands becomes exhausted and our farmers become better informed in matters pertaining to the cultivation of the soil. In past years the farmers of this country had access to such vast areas of virgin lands that good crops were produced without artificial fertilization; when one field became exhausted it was customary to move to another location, where the soil would respond to the simple methods of cultivation then practiced. This system of farming, in which no attempt was made to return to the soil the fertility which had been removed, impoverished the lands to such an extent that for profitable returns a different system must be practiced or it will not be possible to produce sufficient food and clothing to meet the future demands of civilization. There are many factors which effect in one way and another the successful production of crops, but a point of primary importance which has been learned is that for continued success in farming it is necessary to return to the soil the plant food which has been removed.

The greatest influences on agriculture are found in the most advanced of the European countries where the largest quantities of fertilizers have been employed. Today Germany applies more prepared fertilizers per acre than any other nation in the world, and partly as a consequence gets higher yields of farm crops than any other nation. As compared with the United States, Germany produces more than twice as much per acre of the principal food crops, but it

F. B. CARPENTER, native of Massachusetts, graduate of Massachusetts Agricultural College, 1887; spent two years specializing in agricultural chemistry under Dr. C. A. Goessman, professor of chemistry in same institution and director of Agricultural Experiment Station. Seven years with North Carolina Experiment Station at Raleigh, and when Virginia-Carolina Chemical Co. was organized, 1895, became chief chemist, which position since held. Member of Association for Advancement of Science, American Chemical Society, Association of Official Agricultural Chemists, Society of Chemical Industry, and secretary of Fertilizer Division of the American Chemical Society. Was recently appointed by Secretary Daniels as associate member of the Naval Consulting Board to represent the American Chemical Society as State director for Virginia of the Organization for Industrial Preparedness.

must be borne in mind in making this comparison that there are large areas in this country where no fertilizers are used. In those sections where intensive farming is practiced and liberal amounts of plant food are supplied the production will compare favorably with any other country in the world.

If we study the statistics of the United States Department of Agriculture we not only find the largest yields of farm crops in those sections where fertilizers are employed, but there has been a steady increase in proportion to the amount of plant food used and a corresponding decrease where no fertilizers are employed, but there has been a steady increase in proportion in the Southern States. In North Carolina, where the largest amount of fertilizer has been employed, the average yield of lint cotton per acre has been increased from 170 pounds in 1880 to 240 pounds in 1914, while in Texas, where very little fertilizer is used, the yield has decreased in about the same proportion. In certain sections of our country, where the soil has been exhausted by long years of cropping, if it were not for the large supplies of commercial fertilizers profitable farming would be practically impossible. In a large portion of the South the cotton crop is almost entirely dependent for its successful growth on artificial fertilization; the tobacco farms of Virginia, Florida, Connecticut and elsewhere require large quantities of fertilizers, which are not only necessary for its growth, but they contribute very largely to the fine quality for which these States have a reputation.

Thus we might enumerate nearly all the different crops which are grown and find that in different sections they are dependent to a greater or less extent on artificial fertilization. If there were an abundance of farm manures these artificial fertilizers would be less needed, but in these days of specialized farming it is recognized that the natural supply must be supplemented in order to produce the most profitable returns.

Chemical manures are not only useful to supply the necessary plant food, but they have recognized values in the manner in which certain crops can be controlled and the qualities of certain plants improved. The truckers are not only enabled to produce enormous crops on small acreage, but the maturity is materially hastened and quality of product much improved by using liberal amounts of suitable fertilizers. It has been found that the maturity of the cotton crop can be considerably hastened by the use of properly compounded plant foods and thus overcome to a large extent the ravages of the boll-weevil, which has caused such destruction in the cotton fields of Texas and the adjoining States in the past few years.

Thus we might continue to enumerate how the science of chemistry has been of inestimable value, through the agencies of the fertilizer industries, which have transformed by chemical processes the vast quantities of plant food from nature's storehouses into valuable fertilizers, which in turn serve to increase the quantity and improve the quality of crops which serve as food for man and beast.

The slow progress of agriculture in the past has been due in part at least to the want of knowledge on the part of the cultivators of the soil, but with the worn-out conditions of our lands the farmers have come to realize as never before the needs of a better system of farming and are eager to adopt methods which will improve their condition. Science, ever alert to meet the demands of changed conditions, has come to the rescue, and experiments which have been worked out by our agricultural departments and experiment stations are being published and distributed by the millions to the farmers. The information thus furnished covers all phases of the perplexing problems of the farm, but the science of chemistry is the basis of the major portions of these investigations. It has ascertained what vegetation actually demands for its growth, and, as we have seen, points out a multitude of sources where suitable materials for crops can be derived; in fact, this science is intimately associated either directly or indirectly with nearly all agricultural operations. The primitive methods of farming, as practiced hundreds of years ago, served their purpose, but with our exhausted lands and increased population a different system is required to supply the food, clothing or other necessities demanded by the human race under conditions of modern civilization.

While the knowledge of chemistry as applied to agriculture is scarcely a century old, its influence has been tremendous. Never before has there been such widespread interest in the results of scientific investigations as at the present time; every day witnesses new advances, and the world is awakening to the fact that successful farming requires more intelligence and skill than was ever dreamed of in the past. The time will come when every farmer worthy of the name will come to know his own land and its adaptability for different crops; he will learn that for continuous and successful farming the plant food which has been removed must be restored to the soil; he will learn to use economically and profitably all forms of manures and fertilizers. All this knowledge must necessarily stimulate and extend the fertilizer industry. While this growing industry has accomplished much in the past, its influence in the future on the development of the agricultural resources will be broadened until all the soils in this great land of promise shall be made to produce "two blades of grass where but one grew before."

Of the chemical industries in the South, the fertilizer industry is one of the most important. The large deposits of phosphate not only furnish the basis of fertilizers manufactured in the United States, but in other countries as well. Large quantities of nitrogen are secured from cotton seed for fertilizer purposes, and by developing the extensive water-powers sufficient quantities can be secured from the atmosphere to make her independent of other parts of the world. As has been noted, two-thirds of the fertilizer used in the United States are produced in the South, which is an inestimable advantage in developing her extensive agricultural resources. This section is especially endowed by nature with a favorable climate and suitable soil for the production of a great variety of crops. Something of the vast possibilities of the Southern States may be seen when we consider that three-fourths of the world's cotton supply is produced in a small territory as compared to the whole, occupied by the twelve cotton-growing States. This is true of no other great staple commodity of the world, and yet this may be considered nothing as to what can be accomplished through proper conservation and fertilization of the soil.

In the early days, before the lands became exhausted of their virgin fertility, cotton could be grown without fertilizers, but at the present time its production is no longer profitable without the application of liberal amounts of commercial manures. The same is true of other crops, and this section must look to the fertilizer manufacturers more than ever for assistance in developing its vast agricultural resources.

The South has wonderful possibilities in nearly all branches of industrial development, but the greatest progress has been and will continue to be confined to those industries which are allied to agriculture. The fertilizer manufacturer and the farmer are working hand in hand to increase the production of the soil, which will result in a new prosperity for this Southern section of our country.

"Boundless Resources" of Coal, Gas and Other Advantages Should Lead to Founding of Many Chemical Industries.

DR. I. C. WHITE, State Geologist, Morgantown, W. Va.

WEST VIRGINIA has neither gold nor silver, nor any other of the rare or precious metal ores, but she has an almost infinite wealth of coal, limestone, glass sands, building stone (sandstone), clays and shales for brick-making purposes, oceans of brines rich in sodium, magnesium, and calcium chlorides, bromine and other valuable salts.

Her output of petroleum, which exceeds that of Pennsylvania and New York combined, is of the very highest grade in the world, rich in gasoline, paraffine, lubricating oil, and all other valuable products derived from oils of the purest Pennsylvania type.

Of natural gas she marketed in 1914 two-fifths of all that was sold in the entire country, and the manufacture of gasoline from "casing-head" gas, formerly escaping into the air unused has only just begun, although in 1914, the latest year for which we have statistics, she produced more "casing-head" gasoline than any other State in the Union. A splendid opportunity exists for vastly increasing this industry.

The salt brines pumped to the surface daily in connection with the oil production of the Ohio Valley in the Sistersville region, and now permitted to run to waste, ought to form the basis for a large and profitable chemical industry.

In the variety of her coals she is especially rich, having highly bituminous, semi-bituminous, cannels, splints, smokeless, fitted for every kind of fuel, coking and by-product uses.

The iron ores of West Virginia, occurring principally in the counties of Mineral, Hampshire, Hardy, Pendleton and Pocahontas, are fair in quality and equal 200,000,000 to 300,000,000 tons in quantity, according to the most reliable estimates. They are situated near vast deposits of limestone, and a large tonnage of splendid coking coal, and hence when opened up to railway facilities should furnish the basis for a great iron and steel industry, far removed from the dangers of foreign invasion or interruption, in the heart of the Appalachian Mountain system.

With enormous deposits of the purest limestones, easily accessible to cheap, high volatile coals along the lines of the Baltimore & Ohio, Western Maryland, Chesapeake & Ohio, Norfolk & Western and Virginian railways, there should be an enormous production of Portland cement in West Virginia, but up to the present time only one plant of the kind exists in the State, viz., that of the Alpha Company at Manheim, Preston County. Here is a vast field for the profitable employment of capital in this most important industry.

The boundless resources of cheap coal and unrivaled deposits of natural gas should also lead to the founding of many more chemical industries in the reduction of Western ores, while the rapid descent and large volume of her rivers like the New, Gauley, Cheat, Monongahela, Potomac and others present unrivaled opportunities for the cheap generation of electric power and the successful establishment of the many chemical enterprises dependent thereon.

WE NEED TO BE INDEPENDENT.

With this supply of scientific thought to trade upon and the public sentiment in this country to back and buttress the efforts of our scientific men and a tariff policy which will give as just a protection to the dyestuff industry as is given to other industries, there is no reason why this nation should be dependent upon any other nation for its colors, pharmaceutical or explosives. I trust that you people will be able to sound the slogan so well that we shall be not only independent as a nation, but independent economically.—Dr. John C. Hebden, Vice-President and General Manager Federal Dyestuff & Chemical Corporation, Kingsport, Tenn.

Lime for Chemical Industries in the South.

By G. F. Loughlin, Ph.D., United States Geological Survey.

ONE of the most widely used materials in the various chemical industries is lime. Without lime many of the present and prospective industries described elsewhere in this issue of the Manufacturers Record could not flourish in the South. With limestone deposits and limekilns the South is well supplied, although the present considerable output does not begin to represent the enormous and well-distributed deposits available.

G. F. LOUGHLIN, Ph.D.

Of the 12 Southern States represented in the accompanying table, Virginia and West Virginia are the foremost. These two States have ranked among the first 10 of the 44 lime-producing States in the country, mainly because of the large and increasing quantities supplied to the chemical industries. Tennessee, Texas and Alabama have ranked between fifteenth and twentieth, and to these States also manufacturers in many lines are indebted for their considerable supplies of lime.

Value of Lime Sold in Southern States, 1910-1914, inclusive.

State.	1910.	1911.	1912.	1913.	1914.
Alabama	$303,612	$300,787	$297,178	$290,394	$199,814
Arkansas	127,068	109,067	102,833	95,846	92,067
Florida	58,386	49,221	69,958	89,973	64,531
Georgia	29,961	24,067	(*)	13,483	(*)
Kentucky	12,468	15,121	11,577	24,313	26,762
North Carolina	40,455	33,543	30,559	47,838	36,356
Oklahoma	9,700	14,603	13,538	12,160	11,130
South Carolina	.....	(*)	(*)	(*)	(*)
Tennessee	275,701	282,763	316,364	288,400	266,881
Texas	226,952	218,007	236,101	255,893	209,788
Virginia	563,567	483,016	488,628	805,445	763,775
West Virginia	274,205	536,660	734,644	789,901	680,065
Total†	$1,922,075	$2,066,855	$2,301,360	$2,713,644	$2,342,169

*Less than three producers; figures, therefore, not disclosed.
†Does not include concealed values for Georgia and South Carolina.

Distribution of Limestone.—The most extensive limestone deposits in the Southern States are in the Appalachian Mountains. They form continuous parallel belts extending through Western Virginia and Eastern West Virginia, Eastern Tennessee, the northwest corner of Georgia and the northern half of Alabama. These deposits in the Virginias, though prevailingly of the high calcium variety, include a large quantity of magnesium limestone, which extends through several counties.* The proportion of magnesium or dolomitic limestone is less to the Southward, and is found in only one county each in Tennessee, Georgia and Alabama.

The western of these limestone belts in Northern Alabama broadens westward into an extensive area of gently dipping beds extending northward through Central Tennessee and Kentucky, and is continuous westward with a broad limestone area that covers the greater part of Missouri, the northern part of Arkansas and the northeast corner of Oklahoma. This extensive area is also represented mostly by high calcium limestone in Alabama, Tennessee and Kentucky, but magnesian limestone is prominent in Missouri and Northern Arkansas, although very little of it is burned into lime at present.

Besides the southwest extremity of this great area, Oklahoma contains several narrow belts extending northward across its northeastern quarter and three belts of eastward trend in its southeast quarter. In Texas an important belt extends southward from the northern boundary to San Antonio. These deposits are all prevailingly of the high calcium variety, but some magnesian limestone has been burned in both Texas and Oklahoma.

Limestone in the Carolinas is restricted to a few small deposits in the Piedmont area and soft limestone or marls in the Coastal Plain area. The deposits in the Piedmont area, though small compared to those already mentioned, are ample to supply a considerable demand. This area contains limestones in other States, but only in Texas and Florida have they been worked for lime. Florida is largely underlain by beds of shell marl and chalky limestone, but these are mostly covered by comparatively thick deposits of sand and gravel and have been worked extensively only in the vicinity of Ocala. Although no production of lime has been reported from Louisiana, limestone containing 92 per cent. $CaCO_3$ has been quarried for crushed stone at Winnfield, Winn parish, and limestone deposits are present elsewhere in the State.

The purity of most of these limestones is shown by numerous analyses to be quite adequate for commercial demands. The limestones of the Carolinas are not adequately represented by analyses.

Uses of Lime.—Although lime has been used as a building material for centuries, its extensive use in the chemical industries is comparatively recent. During the past few years the annual production of lime for the chemical industries has ranged in value from $3,250,000 to nearly $3,700,000 and has represented about one-fourth of the total value of lime. Lime for agriculture has had an average value of about $2,000,000 annually. In the Southern States lime produced annually for chemical works has been valued at more than $250,000 in Virginia and West Virginia, and relatively small quantities have been produced in Tennessee and Alabama. Tennessee is the only State where lime for paper mills is valued at $50,000 or more per annum, while smaller quantities are produced in Virginia, Texas, Alabama and North Carolina. Tennessee also leads in lime sold to sugar refineries, with an annual production valued at more than $25,000, and Virginia, Alabama and Texas are the only other States to produce it. The same four States supply lime for tanneries, Virginia leading with an annual production of about $15,000. These States, with West Virginia, are also the principal producers of lime for miscellaneous other uses, such as sand-lime brick, slag cement, steel works, glass works, smelters, sheep-dipping, disinfectant, soap manufactories, cyanide plants, glue factories and purification of water.

For some of these uses high calcium lime is necessary; for others calcium and magnesian limes are both suitable, and for a few uses magnesian lime is necessary. High calcium lime is required, or is preferable, for the manufacture of sand-lime brick, caustic soda and potash, bleaching powder, calcium carbide, illuminating gas, ammonia, calcium cyanamide, sugar, molasses, paper (soda process), glycerine, lubricants, candles, potassium and sodium dichromates, in tanning, distillation of wood, refining mercury, preserving eggs, disinfecting and deodorizing, purifying water and purifying sewage. In most of these uses magnesia and insoluble impurities are not actively harmful, but lower the percentage of active reagent. In some uses, such as the manufacture of cyanamide and calcium carbide, they are especially objectionable because of the expense involved in heating useless material. In the manufacture of sugar both magnesia and silica are actively harmful.

Finely ground high calcium limestone rather than lime is generally used in the manufacture of glass, soda ash and ceramics. Portland cement also requires high calcium limestone, but not necessarily stone free from insoluble impurities.

Either high calcium or magnesian lime is suitable for the following uses: Manufacture of calcium nitrate, paints and varnishes, fertilizers, bone ash, insecticides and fungicides, carbon dioxide, rubber, glue, in dyeing fabrics, clarifying grain, refining fats, greases, tallow and butter, removing acidity of oils and as a filler. Both high calcium and magnesian limestone, or dolomite, are used as a flux in blast furnaces and smelters.

Magnesian lime is preferable or required in the manufacture of paper (sulphite process), strawboard, magnesia, basic magnesium carbonate, abrasives (buffing compounds) and flashlight powders. Overburned or sintered dolomite, preferably somewhat impure, has recently been successfully used in the place of imported magnesite, the supply of which has been greatly curtailed by the European war. One variety of this material, called "syndolag," is manufactured by the Basic Products Co. in West Virginia.

From the foregoing account it may be seen that, although lime for the chemical industries is produced extensively in less than half of the Southern States, the supply of limestone is inexhaustible. The quantity, therefore, is adequate to supply future increasing demands of manufacturers in any of the Southern States, and the quality is eminently suited to the wide variety of uses for which lime is employed.

G. F. Loughlin

*Burchard, E. F., "The Production of Lime in 1911." Mineral Resources United States, United States Geological Survey, 1912, p. 15.

G. F. LOUGHLIN, U. S. Geological Survey, received the degree of bachelor of science in 1903 at Massachusetts Institute of Technology, Boston, Mass. During the following year he was assistant instructor in geology and mineralogy at the same institution. Two years later he received the degree of Ph. D. at Yale, and for the next six years he was instructor at Massachusetts Institute of Technology, devoting much of his time to economic geology, both the metalliferous and non-metalliferous branches. During these years he was temporarily employed by the U. S. Geological Survey. Since 1912 he has been a permanent member of that organiation, devoting himself to work in Western mining districts and to the study of the stone and lime resources of the country. Since 1913 he has been in charge of geologic and statistical work pertaining to stone and lime. Published work, of both economic and purely scientific nature, has appeared as U. S. Geological Survey reports and as papers in *Economic Geology, American Journal of Science, Journal of Geology* and other magazines.

Chemical and Industrial Development South Would Remove National Danger.

J. L. Ludlow, President Winston-Salem Board of Trade, Winston-Salem, N. C.

I AM in hearty sympathy with the argument you have recently presented in the columns of the Manufacturers Record in regard to the importance of developing the iron and steel and general chemical industries of the South, particularly from the point of view of national preparedness.

It seems very apparent that such a development and appropriation of the abundant resources of the South, particularly for the making of armor plate and for meeting other requirements of the army and navy, would remove the very serious element of weakness in our national defense, which must continue as long as so much of all such available resources are limited to the present centralized and pregnable position.

"National Preparedness" Cannot Be Made Possible Except Through the Development of the South.

FROM members of the Naval Commission Board in all parts of the country we have received many interesting letters, indicating their realization of the fact that without the adequate industrial development of the South there can be no thorough "national preparedness." These letters will be found scattered through this entire section devoted to "the chemical potentialities of the South," but we have gathered a few of them here that attention may be concentrated upon a study of this situation.

Full Development of South's Resources Absolutely Essential to Thorough National Preparedness.

M. S. PARKER, Associate Member Naval Consulting Board, St. Maries, Idaho.

IT is with pleasure that I respond to the call for an expression of opinion on the chemical potentialities of the South, as well as the vital importance of development of the iron and steel of that section of the United States.

The Manufacturers Record is doing a great work in calling attention to the enormous resources of the South for chemical research. In all the world there is probably no broader field.

With its limitless stores of coal, iron ore, sulphur, oil, gas, barytes, zinc, lead, cotton and water-powers, the South could save the country from existing dangers by a full development of these resources. For thorough National Preparedness it is absolutely essential that all these resources be developed.

A successful raid upon the United States by any two of the great world powers would paralyze the iron and steel industry of the country, bound up as it is in the Lake Superior region. It is absolutely necessary for the welfare of the nation that the Southern fields be developed to their fullest extent to care for this emergency, if for no other reason. The probability of the combination of two great world powers against the United States is not so remote as to be beyond possibility. In fact, the possibility is imminent—so imminent that the United States can ill afford to neglect complete industrial preparedness.

The entire nation must be aroused to the importance of this industrial preparedness for peace as well as for war.

The aim and purpose of the Manufacturers Record should have the hearty support of all true Americans.

"The South Holds the Key to the Immediate Future Welfare and Safety of the United States."

WALTER SHELDON RODMAN, Professor of Electrical Engineering, University of Virginia; Associate Member Naval Consulting Board.

I MOST heartily commend your efforts to set before the public the wonderful potentialities and wealth of resource of the South.

To my mind, one of the most vital questions before the people of this country has to do with the wide development of those natural storehouses of mineral and chemical sources in which the South abounds.

The recent national industrial inventory has set the stage for active co-operation along all lines of "national preparedness," and it can only result in an awakening of a national spirit of enterprise and progressiveness looking toward the ultimate goal of a thoroughly united effort, on the part of all industries, for the common weal. Never before in the history of this country, possibly of the world, has such concerted action been possible.

It is interesting and important in this connection to consider the rapidly awakening interest in engineering education in the South. The next decade will doubtless show remarkable advances in this respect. This movement will react in more intensive development along those lines which depend so mutually upon engineers and financiers for their life and progress.

The South holds the key to the immediate future welfare and safety of these United States. Recognition of this condition is bound to be granted, and with that every effort should be made to utilize to the utmost the riches so easily to be unlocked.

How a Massachusett's Educational Leader Views the South in Relation to the Country.

IRA N. HOLLIS, President Worcester Polytechnic Institute, Worcester, Mass.

I HAVE your letter stating that you are preparing to issue an edition entitled, "The Chemical Potentialities of the South," and I am glad to express my approval, as I look upon developments in the Southern States as most important to the future of the entire country.

The undeveloped resources, if put in the way of use, will be of unquestioned value towards preparedness against invasion by a foreign enemy. At present the region within comparatively easy reach of Boston and New York contains the bulk of our industries available for the manufacture of chemicals and munitions during war. An enemy landing in New England, if well equipped, could in a very short time take possession of the Eastern and Midland States, for we have no effective organization against such an invasion. Our resources and our manufacturing would be of no real use to us because paralyzed. It is important then that the South and West should be made a source of supply for all those articles needed in war. The South has also great potentialities in time of peace and will unquestionably grow into a great manufacturing section. It has the labor, and perhaps the whole race question can be solved by means of the industries.

I sincerely hope that your project is going to succeed well and that your book will have a wide distribution.

Southern Chemical Development Needed in Peace and War.

J. L. BRENNEMAN, Department of Physics and Electrical Engineering, University of New Mexico, Albuquerque.

I HEARTILY concur in your view that chemical development of the South, with its allied industries, is a very important feature of the industrial preparedness program of the United States.

The convenient supply of raw materials, combined with the large amount of potential water-power, will make the development of the South a commercial success in times of peace, and the location of the industries away from the seacoast will be a factor of great value in case of invasion.

Nation's Security Requires Munition Factories Away from Seaboard.

DR. WM. MCCLELLAN, A.S.M.E., New York City.

THERE can be no question that every far-sighted American citizen should do his utmost to further the development of the South. No nation could afford to neglect the enormous resources which all well-informed persons know that the South possesses. I think also that there must be agreement by all to your general proposition that the resources of the country should be developed so that no foreign war could ever cut off supplies of material necessary for the nourishment or protection of the nation. It also goes without saying that the nation should not be content with knowing the mere location of necessary resources and wait until the time of the crisis to develop them. Unquestionably the development of all these resources should be a part of the orderly progress of the nation in times of peace, particularly when the larger part of this development can be done with a profit.

So far as the munition plants along the Atlantic Coast are concerned, it may be unfortunate that they are at such vulnerable points, but in view of the very great immobility of trained labor, as well as its attachment to home and soil, it is difficult to see how any immediate or rapid change can be made. Moreover, the present European war has proven that the demand for munitions in time of peace is infinitesimal compared with the demand in time of war. It is this very fact that has brought all thinking men to the conclusion that adequate preparedness means the maintained ability to quickly, even instantaneously, mobilize all industry when the attack comes. This should be just as serious a part of the work of the government as the preparation of an army or a navy. From the newspaper accounts it would seem as if the munitions were almost more important than were fighting men. The British and the French armies seem to make their advances by occupying ground previously denuded of the enemy by the heaviest kind of artillery fire.

Those having charge of the preparation for rapid mobilization of industry should, of course, give most serious attention to the principles you are contending for. Unquestionably we ought to be in a position to manufacture munitions far out of the range of gunfire of an attacking navy, either sea or air. We have ample mineral resources in our interior, and we should rely on them, irrespective of whatever use we may make of foreign resources in times of peace. In view of the enormous development of munitions plants on the Atlantic Coast, far more than sufficient in times of peace, I do not see how any change can take place in location except as a result of ordinary commercial and business development, which, of course, is usually slow and cautious. This change of location may eventually take place, but for many years to come I am of the opinion that we shall have to rely on our navy absolutely to protect us in case of foreign attack.

I thoroughly believe in a trained citizenry. I believe this training should be such as to enable us to have a huge number of citizens capable of being quickly transformed into subordinate army officers. This does not mean, however, anything like the German, French or Russian standing armies. Such a system, to my mind, unnecessarily cuts down the producing power of the nation. Adequate preparation can be had by other less drastic plans for training. Our safety depends upon sea power and coast defenses, and not upon a large standing army or quasi standing army. Germany's theory of preparedness has involved the making of munitions for all the world in times of peace, and at a profit, so that she would have adequate facilities for herself in time of war. This is a beautiful theory so long as one nation is permitted to work it out. Just as soon as all nations commence to work on this theory, each nation

must maintain its munition plants principally for time of war only, and at a huge loss during times of peace.

Let me say in conclusion, therefore, and in summary, that the nation's security depends upon a large navy and upon adequate plans to mobilize all forms of industry to quickly commence the manufacture of those munitions which it will need in time of war, and which it does not need and can find no market for in times of peace. Such plans of necessity depend upon using the nation's own internal resources, of which the South has a very large part.

"We Are Guilty of Gross Neglect."

CHARLES F. CROWLEY, Consulting and Analytical Chemist and Chemical Engineer, Omaha.

A CAREFUL study in cold blood of the fate of the raw materials of our country should produce convincing evidence that we are guilty of gross neglect. If America is to be for Americans, we must utilize all our raw materials and be able to work them into finished products when necessary. We must manufacture everything from them that can be produced elsewhere to be returned here for sale or perhaps sold in distant quarters, otherwise this is America for the other fellow.

Our country produces raw material in abundance. We have many spots available for the development of water-power. It is not enough to foster the growth of industries in connection with the resources we possess in any one or two particular places to the detriment of other locations. We must establish plants to take care of these items in as many parts of our country as they are found. The destruction of the industries in one section should, in part, be balanced by the larger development of the possibilities in another section. This means the symmetrical development of our country as viewed from any angle.

If private enterprise cannot undertake the accomplishment of this side of our development, then we must force upon the Government that theirs is the responsibility to see that the necessary fulfillment is attained.

"South's Latent Potentialities Have Been Merely Surfaced."

By A. M. SCHOEN, Chairman State Naval Consulting Board, Atlanta, Ga.

THE South has for so long been known as the Land of Cotton that its other potential resources have, in comparison, attracted but slight attention. It is true that in the Birmingham section, where nature in one of her extravagant moods has provided the iron, coal and limestone in immediate juxtaposition, there has been recognition of the wonderful opportunity for iron and steel developments, but even there the latent potentialities have been only surfaced, and in case of the country's need, this section, well inland and not readily reached from either coast or border, might well prove one of the industrial bulwarks. This unquestionably is our greatest point of condensed natural resources, and if its location as to transport facilities is not ideal for times of peace, this same condition makes it that much less accessible to the enemy in time of war.

Beyond this the mountains of Alabama, Tennessee, Georgia, North Carolina and Virginia are rich, especially in iron, coal, pyrites, copper and zinc, not to mention more than 500,000 horse-power of hydro-electric development and more than 2,000,000 additional that can be developed at reasonable cost. These, with the 13,000,000 to 15,000,000-bale cotton crop and the sulphur mines of Louisiana and Texas and the pyrites mines of the other States, leaves us, so far as raw materials are concerned, in a high state of preparedness for the manufacture of high explosives, and from the oil fields of Texas and Louisiana we can draw fuel oil and gasoline for the use of our battleships, automobiles and aeroplanes, while from the by-products of several of our plants benzol and trinitrotoluol are now being produced in quantity. Much of the South's now dormant mineral wealth under the incentive and needs brought about through war would be quickly brought to light, and it would soon be found the part to be played by the natural resources of this section would be no inconspicuous one.

Only One Side to the Question of Preparedness.

By MICHAEL L. LYNCH, M. A. S. C. E., Jackson, Miss.

WHILE usually there are two sides to all questions, I confess I can see but one side to the very important question of National Preparedness, now so prominently before the American people, and but one line of action to adopt, and that is to prepare in accordance with the ancient adage: "In time of peace prepare for war." But if any people are so squirrel-headed or so narrow between the eyes as to oppose such preparedness, they deserve pity rather than censure, as they belong to that class who "never miss the water till the well runs dry," after which they may be found going about with their tongues out, begging the neighbors for a drink.

As you are aware, an important move in this direction has been the work of the Naval Consulting Board, under whose auspices some 30,000 trained engineers have just completed a National Preparedness industrial survey of these United States, the resultant valuable accumulated data being forwarded to Washington for use of the War College and general staff, putting at the disposal of these important bureaus extremely valuable information heretofore unavailable.

In regard to utilization of natural resources of the Southwest, it is generally know that much valuable iron ore is availabe in eastern Texas, but it is not so generally known that a genuine Bessemer ore (Black Magnatite) is available in western Texas, in Llano county, not far from the little city of Llano, the county-seat. This latter deposit has been developed sufficiently to determine quality and quantity, the analysis giving metallic iron at about 66.67 per cent. and being very low in phosphorus and sulphur. Both these deposits are located far inland from the seaboard.

The Development of the South Is Not a Sectional Question, But Is as Essential to the Welfare of Maine in Time of War as Is the Development of Maine Itself.

E. C. JORDAN, Chairman of Maine's Associate Members of the Naval Consulting Board, Portland.

I AM not competent to discuss National Preparedness from the viewpoint of iron and steel production from raw material, such industries being undeveloped in the State of Maine, but I have become aware in my work on preparedness that chemical science (the great factor in modern warfare) now discloses that in the processes in our many mills producing pulp and paper from our forests such plants could be adapted with but few changes to produce rapidly material of the utmost importance to the army and navy.

This is especially true of the sulphite process in the manufacture of paper, and chemical science now indicates certain by-products that can be recovered in large quantities, should occasion require it. In the equipment of such mills there is much that exists in the Du Pont works producing high explosives, and it is now realized that the German chemists have succeeded in adapting such mills to the manufacture of high explosives. I appreciate the great fact that chemical potentialities concerns the nation at peace, but our mental attitude towards them has been quickened to its investigation by the possibilities of a great war.

I further realize that in the South there exist deposits of most valuable raw material, and it is important from a great war point of view that they should be developed, but the subject of Chemical Potentialities knows no South and no North; that is, it has no limit of length and breadth, and I find the subject absorbing in my own Northern locality.

Industrial Development South a Matter of Prime Importance.

By W. C. EBAUGH, Chairman State Directors for Utah, Naval Consulting Board.

THE development of great centers of industry in various parts of our country, North, South, Central and West, in addition to those of the East, will cause us to attain an economic independence very desirable in times of peace, and absolutely essential in the event of a national emergency.

Nature's lavish gifts to the South make industrial development there a matter of prime importance to the nation at large, and the West, with its grain, livestock, heavy and precious metals, extends best wishes to the South in her endeavors to fulfill her "manifest destiny" in this respect.

May the impetus given to your efforts by the present world crisis carry your industrial forces beyond the domain of dreaming into that of doing!

Varied Resources of Texas Should Be Developed for National Preparedness.

W. B. TUTTLE, San Antonio Traction Co., San Antonio, Tex.

THE iron resources of this State might be of great value to the nation if the foreign and Lake Superior ore supplies were shut off.

The iron deposits of Texas are largely in the eastern part of the State and approximately 150 miles from the Gulf of Mexico. It would not be difficult to secure the necessary coke with which to smelt this iron from Tennessee or from other points. Mines and smelters could probably be worked in the South free from interruptions which might occur to the Northern iron industry, and, therefore, from the standpoint of National Preparedness, I consider the development of the Texas iron and steel industry a thing of importance.

It is needless for me to call attention to the enormous production of fuel in the shape of oil that comes from Texas fields. In addition to this there are vast fields of lignite coal, which is a fair fuel for steaming purposes, and on the Rio Grande there are considerable deposits of both a semi-cannel coal and coal which will make coke.

Attention might also be called to the volume of business already being done in cottonseed oil and to the fact that glycerine can be obtained from this oil. Cotton linters, which are turned out in great quantities by the oil mills every year, are also used largely in the manufacture of high explosives.

Chemical Potentialities in Louisiana.

By W. L. HOWELL, Chemist in Charge U. S. Customs Service, New Orleans, La.

THERE can be no real preparedness against war without adequate industrial preparedness in times of peace. Adequate industrial preparedness includes the intelligent development and utilization of our natural resources and potentialities to the best advantage of the country as a whole. What

one section can do in supplying our needs must be unified with what our national needs would be in time of war. No resource should be left unfathomed or untried. It is to the chemist that we must look for help in discovering and devising ways to make adaptable these resources. The reactions of the laboratory become on a large scale the operations of an industry.

The South is peculiarly rich in chemical potentialities, and from our standpoint no State is more richly endowed than Louisiana. Supplementing the great possibilities of the coal, iron and steel production in the Birmingham district, we have here in our State unlimited deposits of pure sulphur, pure salt, oil and gas, furnishing the raw materials and power from which sulphuric acid and other heavy chemicals can be manufactured. With a large annual sugar and molasses crop as well as a huge rice and corn production, there is an unfailing source of industrial alcohol. The cotton and linters production and the enormous amount of wood waste create possibilities for alcohol, paper pulp and nitrocellulose. From our cottonseed oil can be obtained foodstuffs, glycerine and soaps. The virgin pine forests left in the State are the last great source of turpentine and rosin which our country possesses. The chemical-industrial fields opened up by these resources are in some instances developed, or partially developed, but in others they have just been touched. It is only when they are considered as part of the general scheme toward the industrial unity of our country that their real and lasting value will have been reached.

Country Should Heed Lesson of European War.

E. P. MATHEWSON, Chairman Industrial Preparedness Board of Directors for State of Montana, Anaconda.

THE nation is at last aroused to the necessity of industrial preparedness. There are many parts of our country that have not been developed; the South is the most important of these. Its wealth in minerals and in agriculture are almost inconceivable, but the development of this treasure has been comparatively slow.

Anything that can be done to increase the industrial activity of the country should be done. The lesson of the great war in Europe should not go unheeded.

Enormous Resources of the South Invite Chemical Industries.

J. B. RATHER, Professor of Agricultural Chemistry and Chemist to Experiment Station, University of Arkansas, Fayetteville.

AT present the industries on which we are largely dependent for military supplies are concentrated in the East. As has been often pointed out by military experts, this region would be the first attacked by an invader. For this reason it is of very great importance that general chemical industries be developed in the interior of the country and yet so close to the probable base of operations that long hauls would be avoided.

Southern States, like Arkansas and Tennessee, offer many inducements for such activities. Arkansas is potentially a great industrial region. Coal, gas and zinc exist in abundance, and the bauxite mines are perhaps the most important of aluminum in America.

Entirely aside from the standpoint of adequate national preparedness, the enormous undeveloped resources of the Southern States should tempt those not familiar with their advantages to investigate fully the immense possibilities of this region for the establishment of chemical, electro-chemical and iron and steel industries.

Climatic conditions are favorable, transportation facilities are adequate, and the enormous purchasing power of the cotton-growing States gives a market right at hand for the profitable disposal of manufactured products.

South Should Be Seat of Great Chemical Development.

By B. B. Ross, State Chemist and Member of State Board for Industrial Preparedness, Auburn, Ala.

THE publication of your special issue, setting forth "The Chemical Potentialities of the South," is most timely, as a large proportion of the people of this section, as well as of the country at large, are not aware of the fact that in raw materials, fuel supplies and in hydro-electric power the South presents to capital seeking investment in the chemical industries opportunities and possibilities far in excess of those offered by any other geographical division of the country.

Practically all of the raw mineral materials needed in the chemical arts and industries are found in great profusion in the South, and often in close proximity to cheap fuel and cheap power, while the products of forest and field constitute important supplements to those raw materials of the mineral kingdom.

In the scheme of industrial preparedness that is designed to make the nation secure from foreign attack the South should play an important part, as not only iron, steel, copper, aluminum, zinc, lead, etc., for our fighting equipment are produced in large quantities within its limits, in regions remote from danger of invasion, but cotton and cotton oil (as a source of glycerine), and benzine, tolnene and phenol, obtained from by-product coke ovens, would be available for use in the manufacture of explosives upon a large scale. Nitric acid or nitrates could, of course, be produced by the electrical fixation of atmospheric nitrogen, or by the combustion of ammonia obtained either from cyanamid or from the by-product coke ovens.

With cheap and abundant supplies of sulphur and sulphides, salt, limestone, manganese ores, clays, shales, feldspar, phosphate rock, bauxite and other mineral materials too numerous to mention, together with fuels, such as coal, petroleum and natural gas, in practically unlimited quantities, and water-power capable of furnishing electric energy running into millions of horse-power, the South should, within the next two decades, become the seat of the greatest development in the chemical arts and manufactures that has taken place on this side of the Atlantic.

Materials of Tennessee That Invite the Chemist.

A. H. PURDUE, State Geologist, Nashville, Tenn.

TENNESSEE contains a large variety of minerals, some in large and others in small amount, that enter directly or indirectly into commercial chemical processes. In the opportunities for the commercial chemist this State probably is not surpassed by any other one of the country.

Barite or heavy spar, which is used in the manufacture of paint, rubber, lithophone, wall paper and asbestos cement, and in tanning leather, in refining sugar, in pottery glazes, in enameling iron and oilcloth and in the manufacture of barium hydroxide, occurs in Greene, Bradley, Washington, Loudon, McMinn, Monroe and Jefferson counties of East Tennessee.

Bauxite, the source of the metal aluminum and of most of the alum and aluminum sulphate, is produced at Chattanooga, Tenn., and near Elizabethton, in Carter county. It is altogether probable that other deposits will be discovered in East Tennessee.

Chert, suitable for the lining of pebble mills, occurs over large areas of Middle Tennessee. While this does not enter directly into chemical processes, it indirectly is connected with such in the preparation of other material for chemical treatment.

Tennessee contains a great variety of clay in large quantity. Especially is this true of West Tennessee. Kaolin, ball clay, sagger clay, potter's clay and common brick clay all occur in many parts of West Tennessee, but especially in Carroll and Henry counties.

Nearly all of the Cumberland Plateau contains coal of great variety. The annual output approximates 8,000,000 tons. A part of this is manufactured into coke, ovens being located in 11 different counties, the most important of them being at Chattanooga, Rockwood and La Follette. At the first-named place a by-product plant recently has been installed, and it is sincerely hoped that this soon will be followed by others.

The Ducktown district in the southwestern corner of the State has long been known for its output of copper, as this was one of the earliest copper-producing districts in the country. The manufacture of sulphuric acid as a by-product was begun in 1908, and it is currently reported that the profits from sulphuric acid almost, if not quite, equal those from the copper itself.

Fluorite, which is used in the manufacture of opalescent glass, hydrofluoric acid and cooking utensils, occurs in perhaps a limited amount in Smith, Trousdale and Wilson counties. Guano is reported as occurring in greater or less amounts in several of the numerous caves of the highland region in Middle Tennessee.

Red iron ores are common along the eastern escarpment of the Cumberland Plateau and have been worked for a great many years. Brown iron ores occur in other parts of East Tennessee, and magnetic ores in the northeastern part of the State. Brown iron ores of very great variety are to be found in numerous banks on the Western Highland Rim throughout the entire width of the State. This region has been a source of iron and the location of many iron furnaces from a very early date. The ores make a grade of iron of a superior quality. Probably the most important output from these banks at the present time is ferro-phosphate, manufactured by the use of these ores with phosphatic limestone as a flux.

Associated with the zinc ore in certain of the mines of Northeastern Tennessee there is a fair amount of lead in the form of galena. Especially does this occur in the zinc deposits of Claiborne and Jefferson counties.

Manganese, which has been so eagerly sought since the beginning of the great war, occurs in greater or less amount in Bradley, Monroe, Sevier, Cocke, Hamblen, Unicoi and Carter counties, all in East Tennessee. While Tennessee perhaps cannot be expected to become one of the leading States in the production of manganese, it nevertheless can be relied upon for a considerable amount of that material.

A limited amount of nitrates was recovered from the limestone caves of Middle Tennessee during the War of 1812, and again during the Civil War. While there has been no recent investigation into the niter deposits remaining in these caves, they probably can be relied upon for at least a small output.

Middle Tennessee contains a very large reserve of phosphate rock of high grade. It is impossible with our present knowledge of the distribution and thickness of these deposits to make an estimate of their tonnage, but this is known to be immensely great. Deposits of notable value occur in Maury, Giles, Williamson, Hickman, Perry and Decatur counties. It is known that those of lower grade occur in other counties, and some of these may prove to contain rich beds.

The black shale known in geological literature as the Chattanooga shale completely surrounds the Central Basin of Middle Tennessee and outcrops along the eastern escarpment of the Cumberland Plateau in East Tennessee. That part occurring in Middle Tennessee contains a large amount of oil, and

it is thought can be relied upon as a reserve source of petroleum and its by-products after the present oil fields have become exhausted.

Recently East Tennessee has come to be an important producer of zinc. The most important mines at the present time are the ones located at Mascot, in Knox county, and Embreeville, in Washington county. But there are many other mines that have produced zinc in good quantity and will again be opened up for profitable mining, and there are areas in which no development has as yet taken place, but in which there is reason to believe zinc in paying quantities may be found.

At the present time hydro-electric plants are in operation at Hale's Bar, near Chattanooga; Parksville, on Ocoee River; on the Watauga River above Elizabethton, and on the Nolichucky River south of Greenville. A plant is now being installed on the Caney Fork River of Middle Tennessee and another on the Little Tennessee River of East Tennessee. At Maryville, Tenn., hydro-electric current is being utilized for the manufacture of pig aluminum. It is estimated that the streams will supply more than 1,000,000 horse-power for two thirds of the time. By the use of storage basins this amount could perhaps be doubled.

Taking it all in all, the great variety of mineral deposits of Tennessee, and the large quantity of some of them, these taken in conjunction with the large amount of developed hydro-electric power and yet much larger amount of undeveloped power, the possibilities for the chemist in this State are practically unlimited.

To the above statement of State Geologist A. H. Purdue I desire to add a few words:

(1). The recovery of the sulphurous fumes arising from the smelting of copper ores at Ducktown has resulted in making that company one of the largest producers of sulphuric acid in the United States, and to that extent has obviated the necessity of importing iron pyrites from Spain and other European countries to be used in producing sulphuric acid. This is a clear advance for this section in utilizing a heretofore wasted by-product and obviating the necessity of importation from or reliance upon foreign countries for an article greatly needed in the making of fertilizer.

(2). The use of phosphate rock as a flux in the iron blast furnace at Rockdale, in Maury county, has resulted in the production of a very high-grade article of ferro-phosphorus, one far superior to the imported article, and this has lessened or obviated the necessity of importing this article from foreign countries. The home-made article is higher in phosporic acid than the foreign article and can be sold at a less price. This is a distinct new production which should interest the chemist.

(3). The iron ores in the counties just west of Nashville, the capital city of Tennessee, are of very varying analysis. Iron low in phosphorus and free from sulphur is made, out of which strong castings can be manufactured. Iron high in phosphorus and high in silicon can also be made out of these ores. This iron is extraordinarily fluid and is highly adapted for mixture with strong irons to give them fluidity.

(4). There are four grades of phosphate rock in Tennessee in counties in the immediate vicinity of Nashville, viz., the blue rock, the gray rock, the brown rock and the pink rock. They are all of high grade. If the Government plant is established at Muscle Shoals, on the Tennessee River, in Alabama, and the nitrates there made induce the building of fertilizer plants at that point, the supply of phosphate rock must come from these Middle Tennessee counties, so slightly removed from Muscle Shoals.

ROBERT EWING, Mayor of Nashville.

Neglected Plant Resources — Texas Plants Worthy of Industrial Development.

By B. C. THARP, Plant Pathologist, Texas Department of Agriculture, Austin, Texas.

IN the beginning let me explain that by the term "Texas plants" I mean to include both native plants and introduced plants which can be and are successfully grown in Texas. A complete list would really comprise a much larger number than it is practicable to enumerate here; hence the following list is to be considered merely as a few cases cited to show the sad state of industrial neglect in which many worthy plants of Texas and the Southwest are today to be found:

Guayule is an herbaceous perennial plant (Parthenium argentatum) belonging to the aster section of the family of composites. It is a native of Texas and adjacent Mexico, and is valuable for a rubber substitute yielded by its sap. It is being worked to a limited extent, but needs to have the processes for extracting and manufacturing the rubber more highly perfected.

Candelilla (Pedilanthus pavonis) is also a native of Texas and Mexico, belonging to the euphorbia group. It has a yellowish-white milky sap, which yields a rich yellow wax. Like guayule, it is worked only to a limited extent, due to the imperfect state of the process of extraction.

Algerita (Berberis trifoliata), a member of the barberry family, known locally also as wild currant and chapparal, grows native in large areas of southwest Texas. It contains valuable dyestuff, but is untouched commercially.

Osage Orange (Toxylon pomiferum), a member of the nettle family, known also as Bois D'Arc, is another native of Texas, valuable for dyestuff, and also for timber. It has great possibilities and is practically unworked.

Mesquite (Prosopis juliflora), a leguminous tree or shrub, yields a wax from leaves and green pods, whose commercial value has not been determined. The seed contain a high protein percentage, being used to a limited extent for stock food by Americans and for human food by Mexicans. The possibilities of the seed commercially are, like the wax, not known. It is a native of Texas and adjacent Mexico.

Prickly Pear Cacti (Opuntia species) are at present used by stockmen as a forage for cattle. They are very likely much more valuable as producers of wax or gum, but are not so used at all, though the fruit is used to a limited extent in the manufacture of candy. They are abundant from central Texas west and south to Mexico and the Gulf.

Bear Grass (Yucca and near relatives), belonging to the lily family, has a very strong fiber in stem and leaves, industrial possibilities of which are unknown. It is plentiful over the semi-arid and arid portion of the State.

Rice Straw is being used to a limited extent by manufacturers of "straw board," but its possibilities as a paper material are ignored, and thousands of tons waste annually in the fields.

Cotton Stalks, as a valuable by-product of the cotton industry, are not yielding more than a small fraction of the returns possible, because they are not being utilized, except to a limited extent for paper pulp, together with some by-products incident to pulp manufacture. This industry, in its present state of development, is vastly inadequate to take care of anything like the volume of production which the wealth of raw material justifies. This subject is treated much more fully in another article contained in this issue of the Manufacturers Record.

Ramie, China Grass, or **Rhea** (Boehmeria nivea), a member of the nettle family, has the finest and strongest fiber known. It is a good substitute for silk, and is very durable. It is a native of tropical Asia, but is so well adapted to southern United States conditions that it is to be found escaped from cultivation as an ornamental plant and growing wild, especially in the environs of cities, from South Carolina to Mexico. All it needs to make it an industrial commodity of first rank seems to be the discovery of some process for degumming the fiber and making it spinnable.

The **Castor Bean** (Ricinus communis), of the Euphorbia family, is well adapted to all south Texas, but especially so to the eastern section. Development depends solely upon the establishment of manufacturing facilities, so that farmers can dispose of the raw product or "beans."

The **Sunflower** (Helianthus annuus), of the family of composites, has vast possibilities as a producer of oil for culinary and other purposes. It is well adapted to all Texas, except the most arid portions. Nothing is done to industrialize the plant in America, though it is the basis of a well-established industry in Europe.

Camphor (Camphora officinalis), a tree of the laurel family, grows luxuriantly throughout the coastal plain of Texas, from the Sabine River to the Rio Grande. Its adaptability is established, but it is entirely neglected.

These are a few of the plants of Texas which are going to waste because of a lack of knowledge concerning their possibilities, or because of a lack of interest in their industrial development, or both. In all but the last three cases—those of camphor, the castor bean and the sunflower—development depends upon the discovery of processes by which the commercial product may be extracted, or of means by which the present processes may be so perfected as better to fit them for their work. The discovery, or development, as the case may be, of these various processes is pre-eminently the field of chemical research.

Some Chemical Opportunities in Florida.

By R. E. ROSE, State Chemist, Tallahassee, Fla.

IN reference to the chemical industries of Florida, they are at present rather limited, confined generally to the manufacture of sulphuric acid and the preparation of acid phosphate (super-phosphates) for local and foreign consumption. We have a number of such plants in Jacksonville of considerable capacity; also at Port Ingles, Fla.

Another chemical industry, doing little at present, though at one time of considerable importance, is located at Titusville; that is the manufacture of tannic acid extract from saw-palmetto roots. The by-products (fiber) of these tannic acid factories is an excellent material for the manufacture of paper stock. The combination of paper pulp as a by-product of the tannic acid factories would be a profitable business.

A considerable enterprise has been established near Ferry, Fla. (not in operation at present), for the manufacture of wood by-products from pine timber, generally pine stumps, for the purpose of extracting the turpentine, pine oil and rosin; the residium (fiber) is also an excellent paper stock, the paper pulp resulting more than paying the cost of the manufacture of the turpentine, oils and rosins, and showing a very considerable profit. This factory was rather a complete one, but owing to the death of the inventor and superintendent of the factory has been inactive for some time.

There is at present in Jacksonville a concern utilizing saw palmetto leaves in the manufacture of various fiber materials, twine, rugs and mattings. It is claimed that the fiber makes an excellent substitute for binder twine when properly prepared. The tannic acid and fiber from palmetto roots doubtless would be an excellent material and a profitable business in the manufacture of tannic acid-extract and paper pulp.

There has also been some effort made to utilize the inedible fish, menhaden, dogfish and other inedible fish into fish scrap after extracting the oil, the fish scrap being largely used as a fertilizer. At various points on the East

Coast at different inlets, Mantansas, Jupiter, Mosquito or New Smyrna, St. Lucie and New River are ideally located for this very important business.

There has been considerable inquiry in reference to the utilization of the waste products of our citrus groves, oranges, limes and grapefruit in the manufacture of various oils, citric acid, and particularly marmalades and conserves, to say nothing of the utilization of the various orange and grapefruit juices. Some development along this line has occurred at Daytona, Haines City and Lakeland. There is a vast field in this particular line for the utilization of the waste fruit of our citrus groves; also for the utilization of the waste pineapples in the manufacture of pineapple syrup and pineapple conserves there is a large field in the neighborhood of Fort Pierce and Jensen. I understand a concern is now operating near Fort Pierce.

Doubtless a survey of the field would discover other opportunities for the chemical engineer to establish factories for the conservation of many waste products of our forests, mines and orchards. We have numerous natural fibers growing spontaneously that could be utilized in the manufacture of twines and bagging. On the St. Johns River there are vast fields of hibiscus, ordinarily called wild okra or cotton, that contain an excellent fiber resembling hemp. Among other fibers that grow luxuriantly in the State when cultivated is the sansevieria, or "bow string hemp," a plant somewhat resembling sisal hemp, but with a much finer and stronger fiber, which is particularly adapted to our flat woods on the East Coast. It is readily propagated, and yields an enormous amount of material. The extraction or preparation of the fiber is performed with the same apparatus, slightly modified, that is used in the manufacture of sisal hemp in Mexico and Yucatan. In my opinion, the cultivation of this plant and the manufacture of an excellent fiber particularly adapted for binding twine and bagging affords a large and profitable field for the employment of capital and the utilization of our flat woods land.

Some years ago I saw most excellent specimens of this material exhibited in Mr. Jas. E. Ingraham's office, and also in the office of Mr. Miles, the superintendent and manager of the East Coast Canal & Navigation Co. These fibers have been the subject of an investigation by the United States Bureau of Plant Industry, and a number of bulletins or pamphlets on the subject have been issued. I would suggest that copies be obtained, as in my opinion they afford a field for the profitable employment of capital and the utilization of large tracts of Florida lands.

The South as Viewed By Noted Experts.

SOME STRIKING STATEMENTS FROM SPECIAL ARTICLES IN THIS ISSUE.

MILITARY PREPAREDNESS DEMANDS DEVELOPMENT.

Economic considerations may delay the beginning of such industries so far from the main centers of population and trade, but as a measure of military preparedness there is every reason to favor the South in aniline dye manufacture, and the Government, the chemist and the capitalist should fully recognize the potential sesources of that region.—C. E. Lesher, United States Geological Survey.

SOUTH MAY BECOME CENTER AND MASTER OF WORLD'S IRON TRADE.

It is more than possible that the next ten years may see a complete change in the methods of producing pig-iron. The many advantages of electrically-smelted iron are well known. With cheap electricity from cheap coal, found near high-grade limestone and iron ore, the South may yet be the center and the master of the iron industry of the world.—Dr. Charles E. Coates, Professor of Chemistry, University of Louisiana, Baton Rouge, La.

COLOSSAL SUPPLIES.

The great value of such chemical agents as sulphur, salt and other raw materials for heavy chemicals, and the colossal supplies of these valuables in the South, while known to be well recognized, is very well known compared to the occurrence of hundreds of other mineral resources now adaptable to present needs which were formerly valueless.—David T. Day, Ph.D., Petroleum Expert.

THE MOUNTAIN REGIONS OF CAROLINA.

There are few regions in the world where so many varieties of useful minerals have been scattered by nature as in the mountain regions of North Carolina.—David T. Day, Ph.D., Petroleum Expert.

NO REGION ON EARTH MATCHES IT FOR CHEMICAL INDUSTRIES.

The world has yet to learn that no region on earth can compare with the Southern States as a locus for chemical industry.—Dr. Arthur C. Little, Former President American Chemical Society.

COULD SUPPLY THE WORLD.

All the basic raw materials for a highly diversified chemical industry conducted on a scale of magnitude which could supply the world are available in superabundance in the South.—Dr. Arthur C. Little, Former President American Chemical Society.

RESOURCES BEYOND ABILITY TO DEVELOP.

Everyone who has studied the South knows these resources to be available in abundance far beyond the ability of the next few generations to utilize wisely and efficiently.—Dr. Arthur C. Little, Former President American Chemical Society.

THE NATION'S UNDEVELOPED ASSET.

South of the Ohio River and east of the Mississippi lies the most undeveloped territory in the United States.—Dr. H. D. Ruhm, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

GREAT POSSIBILITIES IN PETROLEUM.

To the States of the South, the significant progress made in recent months in the efficient utilization of petroleum is fraught with greater possibilities than to any other area in the United States.—John D. Northrop, United States Geological Survey.

THE STOREHOUSE OF THE NATION.

The South's stores of copper, aluminum, zinc, magnesia, and its salt deposits, oil and sulphur, are for the most part still waiting the capital, the energy and the chemical skill to bring them all to that state of high development which is the only requisite to make of this the supply-house, as it is indeed the storehouse, of the nation.—Dr. H. D. Ruhm, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

SPELLING RAILROAD DIVIDENDS.

The Southern Railroad, the Louisville & Nashville and the other great lines of the South help and are helped by the industries on their lines, and are showing a new appreciation of their privileges and responsibilities, which gives promise of great things for all concerned, since co-operation spells dividends.—Prof. Edward Hart, Easton, Pa.

THE SOUTH PRODUCED ALL BAUXITE.

More than 9 per cent. of the total bauxite marketed in this country in 1915 came from Arkansas, and the other 10 per cent. came from Georgia, Alabama and Tennessee.—W. C. Phalen, United States Geological Survey.

THE SOUTH NEEDS THE RICH AND THE SKILLFUL.

Above everything else, the South needs the rich and the skillful to make available the natural resources, and it makes a peculiar call upon these men.—Charles Catlett, Staunton, Va.

DON'T BE FORGOTTEN BY MANKIND.

One of the strongest human motives is the fear of being forgotten and the desire to accomplish something in a material way that will live and grow and be of service to mankind.—Charles Catlett, Staunton, Va.

WHAT THE SOUTH NEEDS.

What we need above everything else are laws that will encourage the investment of capital, not hamper it; laws that will protect the investor without in the least impairing the dignity or authority of the State.—Dr. Wm. B. Phillips, Austin, Tex.

THE OPPORTUNITY FOR ELECTRO CHEMISTS AND ELECTRO METALLURGISTS.

With such a bountiful array as all the above implies, the inviting field open to electrochemical and electrometallurgical engineers is at once apparent. When we appreciate the fact that the territory under consideration offers almost boundless opportunity for the development of hydro-electric power, that master key which unlocks from nature's storehouse the finished products at once so essential to the peaceful growth of a people's commerce and so necessary in that dread time when grim war threatens the nation's life, it is little to be wondered at that the eyes of the electrochemical and electro-

metallurgical world are turning more and more to bright, beautiful, sunshiny Dixie land.—Dr. H. D. Ruhm, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

CENTER OF PETROLEUM INDUSTRY.

The center of the petroleum industry is now in the South, and here it is believed it must remain for at least another generation.—John D. Northrop, United States Geological Survey.

MATERIALS CLOSE AT HAND.

The chemical manufacturer in the South is able to assemble his raw materials from supplies close at hand, and develops his products without inconvenience and delays of shipments from great distances.—Dr. John C. Hebden, Vice-President and General Manager Federal Dyestuff & Chemical Corporation, Kingsport, Tenn.

COAL FOR THOUSANDS OF YEARS.

The Southern States, taken together, are credited with containing close to 500,000,000,000 tons of serviceable coal. At the present rate of mining and consumption, the Southern coal reserve would last for several thousand years. Our real problem is not how to save the coal, but how to mine it and get it into use at a faster rate.—E. C. Eckel, Economic Geologist and Engineer.

THE SOUTH'S WATER-POWERS.

We may assume that there are about 5,000,000 undeveloped horse-power in the waters of the South. This is about ten times that developed at Niagara Falls, and nearly equals all that has been developed in the country at present.—Dr. W. R. Whitney, Research Laboratory, General Electric Co., Schenectady, N. Y.

INVEST IN MEN.

We would prefer to see the South invest more extensively in her young men; give them the engineering and scientific education more commonly granted to boys of the country.—Dr. W. R. Whitney, Research Laboratory, General Electric Co., Schenectady, N. Y.

EVERYTHING NEEDED FOR NATIONAL PROSPERITY IN ABUNDANCE.

Whether it be petroleum, or salt, or sulphur, or phosphate rock, or clays, or iron ore, or naval stores, or by-products from coal, or what not, the possibilities within this area are practically limitless. There is scarcely a single thing in the long list of materials required for the prosperity of the nation that is not to be had here, and had in abundance, within easy reach of trunk lines of railroad.—Dr. Wm. B. Phillips, Austin, Tex.

FORTUITOUS COMBINATION OF ADVANTAGES.

We see in the South, therefore, a most fortuitous combination of natural advantages making for the production and utilization of a cheaply manufactured and cheaply distributed fertilizer. Nowhere else in the United States do these conditions exist.—Frank S. Washburn, President American Cyanamid Co., Niagara Falls, Canada.

MORE RICHLY ENDOWED BY NATURE THAN ANY OTHER SECTION.

Nature has showered possibilities upon the Southern States beyond every other section of the United States. Will these possibilities be converted to practical accomplishments? The answer is up to the people of the Southern States.—Frank S. Washburn, President American Cyanamid Co., Niagara Falls, Canada.

INEXHAUSTIBLE STORES OF RAW MATERIALS.

The electrochemical and electrometallurgical people will find, in the development of the South along these lines, the hydro-electric power scattered over the country in varying sized units from a few thousand horse-power up to the mighty power at Muscle Shoals, on the Tennessee River, a fitting centerpiece, aggregating more electric energy than any similar scope of the country, and all literally surrounded by inexhaustible stores of every raw material for all their operations.—Dr. H. D. Ruhm, President Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

PETROLEUM LEADS.

From a chemical standpoint the petroleum industry furnishes more promising lines of research than any other great industrial enterprise in this country.—John D. Northrup, U. S. Geological Survey.

The growing and manufacture of sugar-cane is another purely chemical industry in which the South must always be most prominent.—Allerton S. Cushman, Ph.D., Director Institute of Industrial Research, Washington, D. C.

PETROLEUM CENTER IN SOUTH.

The center of the petroleum industry is now in the South, and here, it is believed, it must remain for at least another generation. Developments within the last three years in Oklahoma, Louisiana and Texas have revolutionized previous conceptions of the petroleum reserves in those States.—John D. Northrup, U. S. Geological Survey.

NATION MUST BE SELF-CONTAINED AND SOUTH'S RELATION THERETO.

The lesson of the great world struggle seems to be that if a great nation is to preserve its identity and autonomy in face of international jealousy and aggression it must be self-contained in respect to all the staple necessities of life and industry. The question that we are immediately and very briefly considering in this article is to what extent we in the United States are industrially self-contained and the relation of the development of the South to this situation.—Allerton S. Cushman, Ph.D., Director Institute of Industrial Research, Washington, D. C.

BEST WATER-POWERS IN THE SOUTH.

Nearly all of our great waterways run from north to south, and from the best engineering information available the potential water-powers of Alabama, Tennessee and Georgia hold out the best promise of being worthy of exploitation.—Allerton S. Cushman, Ph.D., Director Institute of Industrial Research, Washington, D. C.

SOURCE OF ENORMOUS POWER.

The response of the chemist has been as gratifying as it has been prompt, and in his response lies a source of enormous power to the States of the South in which the petroleum industry has not yet reached its zenith.—John D. Northrup, U. S. Geological Survey.

VAST RESOURCES OF BARYTES.

The South has vast resources of crude barytes (barium sulphate) which have been developed to some extent and which are the foundation of a chemical industry whose possibilities have just begun to be realized.—James M. Hill, U. S. Geological Survey.

ESPECIALLY ENDOWED BY NATURE.

This section is especially endowed by nature with a favorable climate and suitable soil for the production of a great variety of crops. Something of the vast possibilities of the Southern States may be seen when we consider that three-fourths of the world's cotton supply is produced in a small territory, as compared to the whole, occupied by the twelve cotton-growing States. This is true of no other great staple commodity of the world, and yet this may be considered nothing as to what can be accomplished through proper conservation and fertilization of the soil.—Dr. F. B. Carpenter, Richmond, Chief Chemist Virginia-Carolina Chemical Co.

THE CHEMIST'S UNPARALLELED FIELD.

The South offers to the chemist an unparalleled field.—Dr. Joseph Hyde Pratt, State Geologist of North Carolina.

THE LESSON OF EUROPE'S WAR.

One of the most striking lessons to the American people coming from the experience of two years' European conflict is the need for the fullest development here of the chemical industries which in time of peace furnish us dyes, chemicals and drugs, and in time of war will supply the absolutely essential high explosives.—C. E. Lesher, United States Geological Survey.

The various tariff laws and trade conditions that in the past have hindered, even throttled, development were beyond the power of the manufacturer to control.—C. E. Lesher, United States Geological Survey.

RAW MATERIALS IN UNTHINKABLE QUANTITY AND QUALITY.

Now here we have chemically pure salt from which to make acid, bleach, sodium, hydroxide, sodium carbonate, sodium sulphide and the like. These could all be made in unlimited quantities, chemically pure. This would require a great deal of sulphuric acid, of course, and cheap power as well. A few hours away lies the most remarkable deposit of sulphur in existence, chemically pure and admirably adapted to the making of sulphuric acid by the contact process, already mined and ready for shipping out of Louisiana. Cheap power and raw materials of almost unthinkable quality—and yet nothing is done. They look like the parts of some great engine which have not yet been put together because the master mechanic has not yet come.—Dr. Charles E. Coates, Professor of Chemistry, University of Louisiana, Baton Rouge, La.

Nitrated Cotton: Du Pont Company Is World's Largest Producer.

"COTTON is king" not merely of the South, but also of war, because it is the basic substance in the manufacture of guncotton, and, therefore, of smokeless powder.

The rise of cotton from its low price during the "buy-a-bale" period to its present highly satisfactory price, around 15 cents, was brought about largely by the enormous cotton requirements of the Du Pont Company and others engaged in the manufacture of military explosives.

The fleecy staple, on account of being the purest cellulose obtainable, and because it is obtainable in such large amounts, naturally becomes the important factor in the manufacture of a long list of chemical products. It is not utilized entirely for the manufacture of cloth, but finds an important place in the processes of manufacturing chemicals.

The nitration of cotton is simply treating it with nitric acid of varying strength. The process requires but a few days for its completion. Whether the finished product is guncotton or the soluble cotton of commerce referred to later depends on the degree of nitration, which is governed by the strength of the acid used or by the length of time the nitrating process is allowed to continue.

The process of nitration is exceedingly simple from the theoretical standpoint, but from the practical standpoint in the plant becomes more or less involved and requires the most careful advance research work and painstaking care in every step of the process. It includes a purification so thorough that all foreign substances, dirt and oils are absolutely removed. The final use of the nitrated cotton must be determined on before nitration is begun, for if the nitration is permitted to stop too soon or progress too far, the mass is ruined for the purpose for which it may be needed.

Although the million pounds per day capacity of the Du Pont plant at Hopewell, Va., has been taxed to the utmost during much of the past two years, its enormous output of nitrated cotton was not used exclusively for military guncotton and smokeless powder, and an ever increasing amount was converted into soluble cotton for use in chemical industries. It is obvious that the Du Pont Company is endeavoring to turn most, if not all, of the output of the Hopewell plant into the uses of peace.

There are many uses for soluble cotton, the largest individual use being in the manufacture of leather substitutes. This industry, which has been the field of so much chemical and manufacturing research, has within the past few years developed so rapidly as to tax factory facilities, and all leather manufacturers of importance in this line are now far behind with their orders.

This growing demand for leather substitutes has been brought about by the high price and increasing scarcity of good leather, and the public realization of the weakness of cheap split leather, commonly referred to as "genuine leather," to such an extent as to be spectacular. The uses of leather substitutes are in practically every field of endeavor. The demand comes from the automobile manufacturer, the carriage manufacturer, the automobile and carriage top manufacturer, the car builder, the bookbinder, the shoe manufacturer, the trunk and case manufacturer, the furniture manufacturer, the glove manufacturer, the hat and cap manufacturer, the novelty manufacturer, and, in fact, from practically everyone using a strong, pliable, waterproof fabric.

A good example of this great use is to be found in the plants of the automobile and furniture manufacturers, for when such plants reach the basis of 1000 cars or sets per day, leather of any grade becomes entirely out of the question, because it is impossible to obtain, varies greatly in quality, must be separately cut by experts, is subject to great waste, and is very expensive to handle. In such cases where economies of 1 cent per car or chair are important, leather substitutes win because of superiority over cheap splits in wearing qualities, waterproofness, feasibility of cutting in multiples by machinery and greater ease of use.

The Du Pont Fabrikoid Co., with plants at Newburgh, N. Y., and Toronto, Canada, is the world's largest producer of leather substitutes, and hence an enormous user of cotton. The base or backing of this material is cotton cloth, the weight and strength of which must depend on the quality of the Fabrikoid desired and the use to which it is to be put. This cloth is carefully and artistically coated with soluble cotton to produce the type of leather substitute desired. It has been erroneously stated that Fabrikoid is coated with guncotton. This is not true, as the grade of dissolved nitrated cotton used in the coating is not explosive, and could not be used as guncotton because of its low nitration. Furthermore, in the process of coating it is dissolved in solvents and mixed with oils and pigments so that even guncotton would be rendered non-explosive. It will burn if ignited with care, but the coating supports combustion less readily than cloth, and hence the inflammability of Fabrikoid is low.

The Fabrikoid plants now have a combined capacity of 64,000 standard yards per day. In this manufacture more than 12,000,000 yards of cotton cloth, equivalent to more than 5,000,000 pounds of cotton, are used annually. The raw cotton consumed in coating this quantity of goods will total nearly three tons per day. Even with this enormous production, the company has been unable as yet to build fast enough to keep production to within 30 days of its orders.

The interest of the Du Pont Company in soluble cotton does not end here, for through the Du Pont Chemical Works it sells the major portion of the soluble cotton employed in other American industries. The enormous quantity of soluble cotton consumed can be realized by even a superficial knowledge of the industries affected. Some of these are:

Split Leather Dope—Dissolved cotton prepared for coating and finishing split leathers in different colors and grades.

Patent Leather Dope—Dissolved cotton for treating leathers in the manufacture of patent leathers for all purposes.

Leather Substitute Coating—Dissolved cotton for finishing leather substitutes in all kinds, grades and colors.

Bronzing Liquids—Dissolved cotton that has been further treated for applying bronzing coats to different substances.

Wood Lacquers—Dissolved cotton that has undergone further chemical treatment for the manufacture of a variety of high-class wood lacquers.

Metal Lacquers—Dissolved cotton that has undergone further chemical treatment for the manufacture of a variety of high-class lacquers.

Contractile Collodion—Dissolved cotton especially prepared for surgical use in closing and sealing small wounds and abrasions.

Parlodion—A form of nitrated cotton or pyroxyline bottled in water for use in preparing pure contractile collodion and for laboratory uses.

Mantle Dip—A high-grade of dissolved cotton especially prepared for dipping gas mantles.

Belt Cement—Dissolved cotton that has been especially treated for making a strong, tenacious, waterproof leather cement. There is an additional cement manufactured along the same line that is used as a general household cement.

Leather Renovator—Dissolved cotton leather dope containing pigment for resurfacing worn leather or leather substitutes to restore their appearance.

Enamels—Of any color for coating, coloring and preserving articles of wood, metal or composition.

The use of 15,000 pounds of cotton paper per day in the manufacture of Pyralin plays an important part in the consumption of cotton cellulose. This substance, which is a waterproof, flexible, pyroxyline material, is manufactured in a great variety of forms and colors, one of the best known of which is clear, transparent sheeting so often noticed in the form of windows in automobile and carriage curtains. Its use is enormous for a variety of purposes, such as the manufacture of toys, novelties, flexible windows and scientific instruments, for which purposes it is prepared in sheets of variable thickness.

Transparent sheeting is also manufactured in a great variety of colors, chief of which are amber, green, blue and red. These sheetings find extensive use in the manufacture of glasses, goggles, buttons and flexible windows, such as headlight dimmers and glare shields. The full list of Pyralin sheetings would run to great length, for it is manufactured by the Du Pont Company in a great variety of forms, such as ivory sheeting, tortoise shell sheeting, bronze sheeting, pearl sheeting and opaque colored sheeting.

A great profusion of rods, beading and tubes is manufactured in transparent, opaque and colored Pyralin.

These different forms of Pyralin are sold by the Du Pont Company to different concerns that use them in the manufacture of:

Spectacle frames, rims and cases.
Combs, hairpins and hair ornaments.
Buckles.
Brushes.
Manicure sets.
Toilet boxes.
Mirrors.
Toilet and manicure cases.
Buttons.
Pocketbook and handbag frames.

Powder puff boxes.
Cream boxes.
Hair receivers.
Novelties.
Bathroom fittings.
Picture frames.
Trays.
Clock cases, dials and crystals.
Handles for knives of all kinds.
Shoe and glove buttoners.
Napkin rings.
Signs.
Shoe horns.
Umbrella handles.
Shoe findings.
Musical instruments.
Poultry markers.
Smokers' articles.
Office supplies.
Recording instruments.
Typewriters.
Whips.
Dolls.
Billiard supplies.
Lighting fixtures.

The Du Pont Company not only manufactures the Pyralin sheeting, tubing, rods and beading as such for the use of others, but uses large amounts of this high-class material in manufacturing attractive and useful articles, such as:

Sporting goods.
Dressing and toilet sets.
Buttons.
Collars.
Desk fittings.
Boxes.
Cases.
Knives.
Scissors.
Polishers.
Files.
Tweezers.
Picture frames.
Brushes.
Buttoners.
Musical instruments, pegs and picks.
Pipe bits.
Salad forks and spoons.
Cuffs.
Clock dials.
Teething rings.
Razor and knife handles.
Bottles.
Shirt fronts.
Baby rattles.

As in the case of Fabrikoid, the demand for Pyralin and Pyralin articles far exceeds the limits of the plant. The increase in production has been spectacular, and has far surpassed the most ambitious plans of the superintendents. It is hard to prophesy just how far this development will go, as new uses are being constantly found for Pyralin, and the consumption of this Du Pont product is constantly growing in its old-established uses.

Other Du Pont Chemicals.

The varied activities of the Du Pont Company have made it necessary to take up other lines of chemical manufacture in addition to the production of soluble cotton, and it is today, through the Du Pont Chemical Works, an important manufacturer of other important industrial chemicals, among which may be enumerated:

Refined Fusel Oil—A mixture of various alcohols, of which iso amyl alcohol is present in the largest amounts. This is made in the standard grade and also a grade free from aldehyde for photographic use, for the manufacture of motion-picture films.

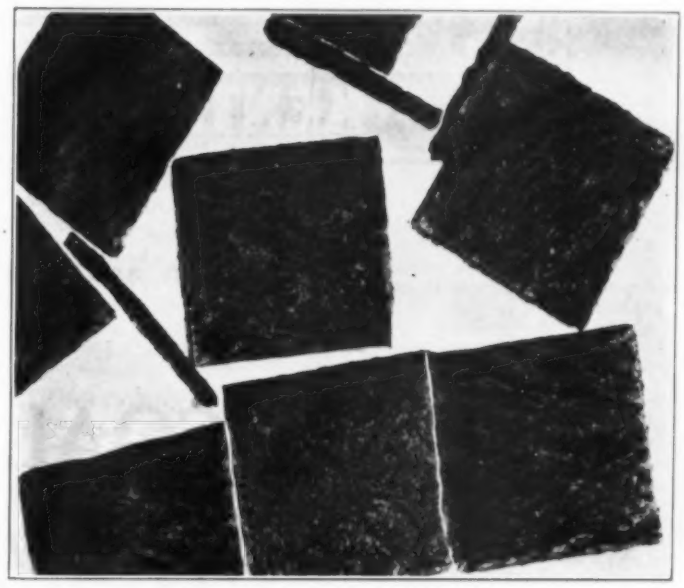
Amyl Acetate—Made in three grades so that a selection may be made for practically any use.

Star Solvent—Another solvent of soluble cotton and a substitute for amyl acetate, but one which can be used only in a comparatively dry atmosphere because of its water-absorbing characteristics.

Ethyl Acetate—Made in a grade to conform with the U. S. P. requirements and also a grade containing 97.5 per cent. ethyl acetate and 2.5 per cent. alcohol.

Ether—Made in two grades, commercial and anaesthetic. The last product is made in two grades, one with about one-half per cent. alcohol, the other with about four per cent. alcohol to meet the specifications of different surgeons.

Methyl Alcohol.
Ethyl Alcohol.



GRAINS OF "BALLISTITE" SMOKELESS POWDER MAGNIFIED 400 TIMES.
Cotton is used in making Ballistite.

Owing to the necessity for producing in America large amounts of coal tar products needed in the manufacture of explosives, the Du Pont Chemical Works entered into the distillation of gas tar, and for two years has been a large producer of the following coal tar derivatives:

Toluol—A water-white volatile coal tar naphtha distilling within two degrees C. (pure toluol) or ninety per cent. below 120 C. (commercial toluol).

Benzol—The lightest coal tar naphtha, water-white, distilling within 2 degrees C. (pure toluol) or ninety per cent. below 100 degrees C. (90% benzol).

180° Benzol—Water-white heavy naphtha.

Heavy Naphtha—Of different gravities running from .910 to .925 and of different widths of evaporation.

Solvent Naphtha (160° benzol)—A water-white coal tar oil distilling ninety per cent. below 160 degrees C.

Naphthalene—White flaky crystals used in the manufacture of chemicals, drugs, dyes, explosives, and moth balls.

Dye Intermediates—A considerable variety suited to different requirements for the manufacture of dyestuffs.

Anthracene Oil.

Flotation Oil—Heavy, strong creosote oil suitable for the flotation of copper and zinc ores.

Dead Oil—A heavy, inexpensive coal tar oil suitable for thinning pitch and tar paints and manufacturing lamp black.

Pitch—Coal tar pitch of four classes—roofing, waterproofing, hard, and insulating.

Tar—Dehydrated tar suitable for the manufacture of roofing, insulating, and road binders.

Since the Company entered this industry to secure toluol and benzol for the manufacture of explosives, these products have not been offered for sale, but on the completion of large smokeless powder contracts the production of these two commodities will be in excess of the Du Pont Company's requirements and will be marketed.

Those interested in learning of the ramifications of the Du Pont Co. and its progress along chemical and industrial lines, which are much more varied than this article indicates, should send for a copy of "Du Pont Products Book" and booklet describing the different Du Pont chemicals.

Address Du Pont Chemical Works, Wilmington, Delaware, or the New York Sales Office, 120 Broadway, Equitable Building.

A general sales store and sample room is maintained at Pennsylvania avenue and Boardwalk, Atlantic City, N. J., to which visitors are cordially invited.

THREE KINDS OF SMOKELESS SPORTING POWDERS IN THE MANUFACTURE OF WHICH MILLIONS OF POUNDS OF COTTON ARE USED ANNUALLY.

HOW GOOD ROADS AND AUTOMOBILES COULD HAVE WON THE RAILROAD FIGHT.

HAD the railroad strike gone into effect the railroads and the railroad employes would, we believe, have suddenly waked up, as the country would have done, to the fact that good roads and the motor truck and the automobile would have solved many of the problems which the country imagined it would face in the way of starvation by reason of the railroad situation.

If the strike had gone into effect on September 4, there would have been a sudden swing of the automobile and the motor truck into transportation purposes for foodstuffs, for merchandise and for travel which would have amazed the land. Under these conditions we would have had a demonstration of the advance in the automobile industry and of the facility with which the millions of automobiles in this country could suddenly have been turned from pleasure vehicles into the business of transportation of men and things.

We are inclined to think that the railroad brotherhoods would suddenly have realized that they were beaten before they got well started.

Cleveland, Ohio, was prepared to meet the threat of the railroad strike. It had already mobilized the whole automobile situation, and the story sent out from that city gives the following interesting facts as to how Cleveland was going to meet this condition. It is as follows:

> The threat of a general railroad strike carried no such dread to Cleveland as to many large cities. While Cleveland is intersected by six railroad systems, it is also the focal point for a system of brick highways that is regarded by experts as the most complete and substantial in America. When fear of a strike was at its highest, plans were practically formulated for making Cleveland independent of rail transportation so far as the necessities of life are concerned.
>
> A preliminary survey showed that the city had supplies to last variously from one to twenty days, the shortest period being for milk and the longest for meat. Cleveland produces 75 per cent. of its flour, and the raw material, wheat, comes largely by boat.
>
> Mayor Harry L. Davis took the lead in calling for a volunteer mobilization of motor trucks, to take effect in case rail transport stopped. It was found, according to the Cleveland Automobile Club, that paved roads reached practically every dairying locality which serves the city. The latent meat supply within trucking radius was estimated as sufficient to last for two months.
>
> In the matter of fresh vegetables and fruits there was never a moment's anxiety. Paved highways have so stimulated market gardening in the vicinity of Cleveland that the city is actually an exporting point for vegetables rather than an importing point. Most of these gardeners have greenhouses and reach the Cleveland market at least once daily the year around.

The story, though a little old now, is worth publishing for the lesson it conveys as to the value of good roads, the local development of food supplies, and the ability to handle foodstuffs by automobiles and trucks wherever good roads exist.

Before the days of good roads and the automobile a general railroad strike, even if it had lasted only a week or two, would have been exceedingly disastrous, though not, however, so disastrous as was the surrender to the railroad men; but with the automobile and the motor truck at the command of every village and of tens of thousands of farms, the way in which the situation would have been handled would have stimulated every energy of every community of the country. Some heavy things, such as cotton and coal and iron and wheat, would have been delayed in transportation, but there would have been no general breakdown of the food supply or of the ability of people to move around. The country really threw away a good opportunity to show that it could to some extent be independent of railroad trainmen in such an emergency. The value of such a lesson would in itself have been almost worth the cost.

The wild reports that were put out for effect, that the country would starve and go straight to perdition commercially and industrially, took little cognizance of the power of the people of the country to meet the situation through trucks and automobiles.

The more this situation is studied the vaster becomes the importance of the building of good roads and the development of the automobile and the motor-truck industry.

We are strangling the railroads by such legislation as the eight-hour bill and other work that has been done in the national as well as in State legislation. We are making it impossible to build new lines, the construction last year being smaller than for any preceding year in the last half-century—smaller, indeed, than any year since 1862, during war days. It is, therefore, incumbent upon counties, towns, cities, States and the nation to throw into the building of good roads all available capital and all possible energy. With systems of good roads radiating from every important town and city in the country, we would never again be at the mercy of railroad trainmen. The automobile and the motor truck and good roads may yet prove the salvation of the nation from such acts as that which, on September 2, threw to the winds the honor and the independence of the nation.

SEATTLE, LIKE BIRMINGHAM, SHOWS WONDERFUL ECONOMIC AND MORAL IMPROVEMENT UNDER PROHIBITION.

ON July 27 last the MANUFACTURERS RECORD published a statement by Mr. E. W. Barrett, editor of the Age-Herald of Birmingham, regarding the effect of prohibition upon business and labor conditions in that city. From the facts presented in that interesting survey of conditions under prohibition it was shown that all crime and disorder had decreased practically 50 per cent., and that "every passing month demonstrates more clearly that the monetary loss from prohibition is being offset in so many other ways—both direct and indirect, both financially and morally—that the result is startling." Such statements are further strengthened by the admission of Mr. Barrett, in which he said: "It is known in Birmingham that I am no prohibition fanatic, having never voted that ticket, but in fairness to the prohibitionists I cannot stand idly by and see the results of their efforts minimized and destroyed by false and absurd reports."

Now comes another editor, Major C. B. Blethen of the Seattle Times, who says his paper "fought its damnedest against prohibition," but who, in a lengthy discussion of the prohibition question in the Richmond Virginian of September 9, says:

> The Times admits it was wrong when it said during the campaign against prohibition that the enforcement of the statute would mean miles of empty stores in Seattle, reduced bank clearings, reduced bank deposits, reduced rentals, reduced realty values and general business depression. Six months ago the law went into effect. None of these dire things prophesied for the first half of the year 1916 have occurred. On the other hand, Seattle has prospered wonderfully.
>
> I am not attempting to say that prohibition, when enforced, makes prosperity. I have my own opinions about that, which have no possible value in an article of this kind. But I do say that certain wonderfully prosperous and gratifying conditions have followed the enforcement of the law, regardless of what caused them to happen, and that the disasters which I personally believed would occur have not happened, nor do now I believe they ever can happen.

Let us see how prohibition worked out in Seattle, the largest city that has ever had a dry law. Major Blethen sums up the great benefits, economic and moral, that have been derived from prohibition in Seattle in the following:

> Apparently, without any important increase in population to account for it, the dry goods houses, small stores, haberdasheries, shoe stores, meat markets and groceries have been doing a *largely increased business.*
>
> In spite of the reluctance of many real estate dealers to discuss conditions, rentals have not gone down appreciably save in old saloon locations, where false values were maintained as long as it was legal to sell liquor. On the other hand, many large firms are paying higher rents. And it should be said, in passing, that there are two sides to the question as to whether lower rents would do Seattle any harm.
>
> Building permits have declined in amount as compared with the first six months in 1915. The difference is $174,000, and this is the only item in the whole list which is unfavorable.
>
> Bank clearings increased more than $55,000,000. Bank deposits in general have greatly increased. Savings accounts have increased in numbers and totals.
>
> Real estate transfers have increased and higher prices are being paid for property than in the first six months of last year.
>
> Collections have wonderfully improved, being called by certain authorities 50 per cent. better than in 1915.
>
> Suicides and murders have decreased one-half. This item would not have been mentioned but for the public assertion of liquor dealers that crimes of violence were increasing in Seattle as the result of the sale of "drug-store" or "blind pig" liquor.
>
> Again and again the newspapers of Missouri, Montana and California have printed assertions that crime was much more prevalent in Seattle under the dry law than previously. Let us look at the figures:

Total arrests going to police blotter in first six months of 1916	10,152
Drunks turned loose after sobering down, names not going to blotter, in same period	1,136
	11,288
Total arrests first six months 1916, none being turned loose without names going to blotter, and including violations of liquor law, which should not properly be included in comparison	5,444
Total human beings kept out of jail, apparently by operation of prohibition law	5,844

> Think of the sum total of human anguish being reduced in that amount! I confess that it makes me ashamed of myself for having dared to argue that the saloons should not be disturbed.
>
> We were wrong when we said prohibition would ruin Seattle and the State of Washington. And we are going to do everything we can to stop the campaign of misrepresentation and vilification waged against the name and reputation of Seattle by the newspapers of other States.

ONE ILLUSTRATION OF MISTAKEN VIEW OF RAILROAD AND LABOR SITUATION.

Brevard, N. C., September, 4, 1916.

Editor Manufacturers Record:

Your article on the Railroad Strike. As to Mr. Wilson granting an 8-hour day to railroad men, I am thinking he did the right thing. It will give more laboring men a chance to get in on the Road, make up the loss of the two hours per day for which there is plenty of men with families are hard workers and are trying to make a living just the same as you and I are doing; have children to send to school, living hard and working the same way under a Boss from seven in the morning until six at night. Why not cut down the working hours and force more men to go to work. It isn't right for one-third of our men to work while one-third loaf, play cards, drink and do nothing at all, and the other third figures to get all of the money that one-third is making and what they can get out of the dead heads; do you think if a laboring man made you $5.00 per day and you paid him $1.50 you would say to yourself if that fellow don't know what he is making it is all right; but just as soon as he finds out what you are making on his labor he is going to want more money and less hours. You can't blame that fellow can you? No, he has got children and he loves them just the same as the Big Railroad Man loves his while he is making his $2.50 or $4.50 per day working hard all day and perhaps half the night in the rain and snow and ice while our Big Boss is sitting at home smoking his good cigars and sitting in his big easy chair enjoying life with his dear ones at home, perhaps drawing ten to fifty-thousand dollars per year. No things are not divided the right way.

No don't raise the Freight. Lower the big fellows salary; put things on more of an even base if you work six hours and get ten dollars why make the laboring man work ten hours for four dollars Isn't his work just as necessary as yours would be; well why not cut his hours to eight and your salary to $7.50 then you would make a fuss right, so we will just raise the freight and make the rest of the poor devils pay it and just pay your $10.00 right on for six hours work that will be all o. K. That is the way you see it but I see it in a different light. If you had just so much work to do and had to get it done in a certain time you would just work one man ten hours per day until you finished while there were other men wanting a job, so if you cut off two hours then you couldn't do that work with one man then the other fellow would get a job. Don't you see he has got to live somehow, if he can't get work he has got to get it some other way, stealing or begging. He has children as same as the other fellow. We have all got to live, God put it here for us, and I don't think he would let a child be born unless he seen that there would be plenty here for it to do. I think the 8-hour is all right, but of course I will have to help pay it as long as I live and eat. It wont hurt the big fellow as he will just draw his fifty thousand or ten thousand right on. Now don't think I am mad or anything. I think a lot of the Manufacturers Record and also the Editor so I guess my letter will find its way to the waste basket but if you see anything that is worth printing you can do so. Inclose you will find check for four dollars ($4.00).

T. B. CRARY.

Mr. Crary has missed the whole point at issue. The railroad men were not seeking shorter hours, but a heavy increase of pay. They do not expect to work only eight hours; they expect to work just as long hours as they do. But first they want ten hours' pay for eight hours and then extra pay for all over eight hours. The MANUFACTURERS RECORD blames no one for seeking by honorable means to earn and secure the largest possible pay for his work, but it must protest with all the power at its command at the methods used by the railroad men—

at their bulldozing tactics, at their refusal to arbitrate based on a thorough investigation of the whole subject by disinterested men. There is now work for every man who wants to work, but no one has yet found a way to make those who, according to Mr. Crary, "loaf, play cards, drink and do nothing at all," work, and the rest of us who work have to bear the burden of carrying these loafers.

KILLING THE GOOSE THAT LAID THE GOLDEN EGG.

THE editor of this paper is fifty years old, and for over forty years he has worked not less than nine hours a day and not more than fifteen. There was a time when he could get no work for ten hours per day at $2. That was not over thirty years ago, and he was one of the best printers in the South, too.

How do you suppose the farmers of the country who put in fourteen hours a day from March till December, especially those in the cotton fields of the South, are going to regard this strike?

The railroads of the nation, along with everything and everybody else, are just recovering from the prostrating shock of the European war. Everything and everybody made concessions to pull through that panic except the men who are now asking for an advance in wages, which, if granted, means a tax of $100,000,000 a year on the railroads, and which, if imposed on the railroads, must result in an additional tax of that amount on the commerce of the nation, because 25 per cent. of the railroads are now in the hands of receivers.

Is this strike just, is it in order, can those promoting it receive the sanction of the public? We answer most assuredly "No," and we believe this is the sentiment of the whole nation, excepting only a few of the strike leaders, their business agents and agitators.

If ever an axe was raised to kill the goose that laid the golden egg, it is in this instance.—Cotton and Cotton Oil News.

The editor of the MANUFACTURERS RECORD can beat the editor of the Cotton and Cotton Oil News, for he has for forty years averaged over nine hours a day and many times more than fifteen hours a day. Nevertheless, while sticking at it and trying to play the game fair and square, we would see the hours of all employes reduced much below the number which the writer has found it necessary to work, but we fully agree with the Cotton and Cotton Oil News as to the unspeakable folly of the action of the railroad men.

BEERLESS BREWERY PUT TO HELPFUL USE.

A MUCH-WORKED argument against prohibition, put forth especially when "business" and "financial" interests talk against prohibition, relates to the loss to both capital and labor which, as claimed, would follow the closing down of breweries now operating in "wet" States. One brewer in the State of Washington, according to newspaper reports, has discovered that the prohibition law, instead of destroying his brewery, has opened up to him a much more profitable business. He is now bottling and pasteurizing milk and manufacturing cheese. His big beer trucks are hauling milk instead of beer. His steam plant and refrigerator apparatus are cooling milk and cream and curing cheese, and he finds it necessary to employ even more men than before.

Intelligence and enterprise can always adapt themselves to changed conditions, and as a matter of fact it is notorious that a very considerable part of the people engaged in the liquor business would be glad to employ their time and money in any enterprise that bears the badge of legitimacy, even with less remunerative returns.

The Washington brewer's experience shows the way. It might likewise be profitable to study the adaptability shown by New England captains of industry. For example, when locomotive building became unprofitable in Massachusetts, the Taunton Locomotive Works turned to the manufacture of printing presses and snow plows, and the Fall River Iron Works quit iron entirely when Fall River ceased to be a favorable situs for such enterprises and built up one of the greatest cotton manufacturing businesses in the country.

It should not be impossible, therefore, for even a brewer to turn his activities and investments into channels not only beneficial to the country, but profitable to himself and satisfactory to business and banking interests as well.

Shall It Be Muscle Shoals?

INVESTIGATION PROCEEDING AS TO THE SITE FOR THE GOVERNMENT NITRATE PLANT.

[Special Correspondence Manufacturers Record.]

Washington, D. C., September 8.

No decision will be made by the War Department with reference to the selection of a site for the proposed Government nitrate plant until November.

There are two phases of the investigation that is now being made under the direction of Secretary Baker of the War Department, to whom the entire problem has been referred. One phase concerns the determination of the process which the Government should adopt in the manufacture of nitrates for war explosives and fertilizers. The other concerns the site where water-power shall be developed in connection with the manufacture of nitrates. The decision with reference to the second phase, the selection of a site, depends largely upon the decision with reference to the first phase, the selection of the process. If, as has been expected, the Ordnance Bureau of the War Department decides that the Government should adopt the cyanamid process, the selection of Muscle Shoals as the site of the new nitrate plant is inevitable. There is no other site that compares with it for the large development of water-power.

The greatest development possible at Niagara Falls is 500,000 horse-power. This is the maximum fixed by law. If there were no restrictions, there would be a possible development of 7,000,000 horse-power. The fact that 500,000 horse-power is available there has resulted in an investment of $125,000,000 in hydro-electric plants at Niagara Falls. This clustered development is probably the greatest in the world.

There is possible at Muscle Shoals a development of 680,000 horse-power. This will exceed by 180,000 horse-power the possible maximum development at Niagara Falls. It would be the salvation of the fertilizer situation in the South and Southwest. It would be the greatest boom to the prosperity of the whole country. The selection is considered inevitable if the War Department selects as its process the system of nitrate development which provides fertilizers as well as the ingredients of powder for war purposes.

President Wilson personally has as yet given little consideration to the subject brought before him through the enactment of the army bill, with its appropriation of $20,000,000 for the establishment of a nitrate plant on a site to be selected by the chief executive. He has referred the whole matter to Secretary Baker of the War Department for a report. Secretary Baker has asked General Crozier of the Ordnance Bureau to investigate the processes with a view to selecting the one that will best serve military purposes. The National Academy of Sciences also has been asked by President Wilson to study the sources and processes of nitrogen. The academy has appointed a subcommittee known as the nitric-acid committee. On this committee will serve such eminent men as Dr. Noyes of the School of Technology of Boston, who is chairman; Dr. Bacon, who is also a member of the Naval Consulting Board; Dr. Herty of the University of North Carolina, and several other eminent scientists. At the request of the War Department Dr. Parsons, one of the experts of the Bureau of Mines, is making an independent investigation.

The reports of these committees and officials, as soon as inquiries are completed, will be referred first to General Crozier and then to Secretary of War Baker.

Meanwhile, the Board of Army Engineers is investigating various sites. Muscle Shoals has already been thoroughly investigated by the Bureau of Army Engineers and its development recommended. This recommendation was made long before there was any thought of a nitrate plant. The army engineers recognized that it was the best water-power site in the United States, and then recommended that the Government itself bring about the development.

Augusta, Ga., has put in a claim for the advantages of water-power development in the Savannah River; Columbus, Ga., has pointed out the advantages of a site in the swift-flowing Chattahoochee, while there have been similar claims put in by Columbia, S. C., the State of Washington and other communities. The advantages of Muscle Shoals, however, have impressed all the members of the Board of Army Engineers. They have made no decision, and will not make any decision until the other phase of the investigation is completed. If, for instance, the Haber process of producing nitrates should be adopted, no large amount of water-power would be needed. If the War Department should decide to manufacture by-product coke ammonia, which is the equivalent of ammonia-sulphate, there still would be no need for a great water-power development. Any one of the various sites suggested might then be considered. In connection with these various processes, however, there will be no solution of the fertilizer problem, or the shortage of fertilizer which has had its effect upon the cotton crops of the South. The cyanamid process unquestionably will supply all the need for fertilizer, as well as the need for the nitrates for powder for military purposes.

Thus logic points unwaveringly to the selection of Muscle Shoals if a large amount of water-power is desired.

None of the reports will be in the hands of Secretary Baker, until late in October, and it is hardly likely that Secretary Baker will be able to digest them and make his personal report to the President until November. The scientific investigation is now proceeding while the sites are under consideration. There is some evidence of political pressure, but it is hardly likely that it will be successful, and if an impartial decision is rendered, experts in Washington do not see how there can be any decision other than the selection of Muscle Shoals, where the new nitrate plant would be established at the point where fertilizers are most needed, and from a military standpoint, in the best strategic location, useful in peace and safe in case of national danger.

THOMAS F. LOGAN.

Humiliated as Never Before.

A. S. PRESTON, Treasurer The Jasper Trust Co., Jasper, Ala.

For years I have read the MANUFACTURERS RECORD and believe that, today, it is the greatest exponent of American principles on the continent. In fact, I have come to regard it as a textbook, and I feel that it is a duty I owe you to express my appreciation of the position taken by the MANUFACTURERS RECORD on the recently threatened railroad strike. I, the son of an officer of the Confederate Army, and a life-long Democrat, have, within a week, been humiliated as never before in my life. I have seen my party, now the dominant party at Washington, stand and deliver at the point of a pop gun, sacrificing principle in abject cowardice.

As you aptly stated in your editorial, the added burden of one hundred million dollars to a hundred million people amounts to but little, but the sacrifice of principle and the precedent that has been established are of such far-reaching importance that I fear but few people today realize what it really means. I confess that I myself am at sea and wonder at what port we will finally land.

Not a Believer in "Peace at Any Price."

W. B. ROPER, Secretary-Treasurer The North Carolina Pine Association, Incorporated, Norfolk, Va.

The statement made on the first page of your Bulletin for September 2 is so fully in accordance with my views and the views of the members of this Association, so far as I have been able to learn, that I must write and congratulate you upon the splendid expression you have given. The President and Congress have made a most humilating surrender of principle and right in order to obtain temporary adjustment from the threatened strike. I am not a believer in "peace at any price," and think this is one case in which it was best to fight.

The Philadelphia Friends on the Mexican Situation

By Courtenay De Kalb, Mining Engineer and Geologist, Tucson, Ariz.

The Peace Committee of Philadelphia Yearly Meeting of Friends has issued an address to the editors and periodical press of the United States accentuating a truth for which I need go no farther than their own circular for the apt quotation, "The popular conception of the Mexican situation is based on misinformation and ignorance." The worthy Friends clearly do not know that they are misinformed. That is ever the plight of people who are misinformed and ignorant concerning a question. In this particular case the Friends apparently belong to a large majority. Just how so intelligent a people as our own should so long have swallowed falsehood and have jumped to wrong conclusions about Mexico is a little difficult to comprehend. President Wilson has been a disappointment to many of his friends. Frankly, many of us had hopes that we would find him broader than Mr. Taft, wherefore we supported him in 1912. It was a shock to discover that he actually closed his doors against those who came with offers of information. It is to be admitted that every one will bring some misinformation along with the things that he knows, but surely men who have lived long in Mexico, who are acquainted with the highways and byways as well, who have lived for years with the Mexican people, have become the familiar friends of Mexicans of high and low degree, speaking their language with them, sitting at their tables with them, discussing affairs public and private with them through years of such intimacy, are better qualified to tell the truth concerning the political conditions, the respectability of the self-constituted revolutionary chieftains, and the aspirations of the people, than men who have never lived in the country, who are unable to converse with them in the vernacular, and who must rely entirely upon what others tell them. Who could render the best account of the people of the United States, Mr. Asquith or Lord Bryce? By whom would you rather be judged, by Lord Bryce or M. Briand? Mr. Wilson sent Mr. Lind to judge Mexico. It was precisely the same as if President Poincare should have sent M. Briand to give him the data for dealing with us in a crisis. It seems strange that the American people cannot gauge their acts by the instructive parallel. It is a fact that one after another, men saturated with information upon Mexico, men as full of the spirit of honor as Mr. Lind dare be, went to the White House and were denied audience with the President. Mr. O'Shaugnessy was full of knowledge, and all the world knows how disdainfully he was received on his return from Mexico. If the Friends of Philadelphia desire some straight truths about Mexico, I commend them to a reading of the recent volume by his wife (A Diplomat's Wife in Mexico). Let it be remembered, also, that Mrs. O'Shaugnessy is a woman capable of discriminating observation, not only because she was in a high position in Mexican society, where she had an opportunity to see deeper than a political emissary, but because, as the daughter of Dr. Elliot Coues, she had been brought up in an atmosphere of culture and careful scientific investigation, where the weighing of evidence was understood and practiced.

It sounds strange to one acquainted with Mexican history to read that education and marriage have been church monopolies. That has not been true since the days of Juarez, and he died in 1872. Under Diaz the parochial school had become of secondary importance, just as it is in the United States. The development of the public school system had advanced so far under Diaz that I defy anyone to point me to any organized town where some sort of "Escuela Municipal" did not exist independent of any church school that may have been maintained. Personally, I have ridden seven times across the Sierra Madre in Mexico by different routes, some of my journeys on horseback having exceeded 700 miles, and I can testify that I have never found a single town in the remotest part of the mountains where a school was not present. In my letters to The Nation, some of them written 16 years ago, I was constantly calling attention to the spread and the relative excellence of the Mexican public school system. In a letter published in The Nation February 15, 1900, I find: "And as the paths of commerce and the pursuit of industry have been rendered safe, the schools have followed under the guidance of the State, even into the remotest hamlets of the mountains." Again, in an article on "Culiacan and the Way Thither" (The Nation, July 16, 1903), I extract: "The college is an institution of no common merit. Dominated by the genius of Dr. Ruperto Paliza, a gentleman of broad culture and high attainments in science, it has not allowed the superficial and ornamental to overshadow the practical in its curriculum. The courses in mathematics, physics and chemistry are rigid and thorough, aided by laboratories well equipped with modern appliances. The Escuela Modela de Porifirio Diaz (the Porfirio Diaz Model School) is in very truth a model school, following French rather than American methods. In fact, French culture has firmly established its canons of tests in the intellectual development of this part of Mexico. The industrial school is another institution in which all Culiacan takes special pride, a reformatory for little waifs, where they are given a good elementary education, with instruction in useful trades and arts." In 1912 I had occasion to visit Culiacan again, and this time I was conducted with pride by the Governor of the State to inspect the high school which had been in operation for a number of years, and recently moved into magnificent new quarters. The building occupied an entire city block, was splendidly appointed, with abundance of apparatus for instruction in elementary science, carpentry, blacksmith work and the domestic arts. The walls were hung with the best modern maps, reference books were available in Spanish and French, and I am sure that the Society of Friends would applaud any school board in this country that would do what the school administrators there had done, and what they had been doing in hundreds of schools throughout Mexico, under the initiative of the Diaz government, namely, to hang in every schoolroom charts showing in natural colors the injurious effects upon the human organs of the consumption of alcoholic drinks. It is true that Sonora has recently declared against liquor, and it must be remembered in this connection that Sonora is dominated by General P. Elias Calles, a former schoolmaster under the Diaz regime, and that one of the things which de la Huerta, sent by General Carranza to wrest away the civil authority from Calles, came authorized to do, was to rescind the prohibition decree of the local ruler. General Calles was asked to turn over the civil government to de la Huerta and then go to see the first chief at the capital. Calles, however, whipped the new governor into submission, and sent word to Carranza that he was too busy to visit him just then. He reflected upon others who had gone and had failed to return. It is reported that the administrative assassinations in the City of Mexico for the month of July numbered over 300, and "the adobe wall at sunrise" is the penalty for any independent thinking or talking in Mexico today, as it has been throughout the revolutions, notwithstanding that the municipal elections are called for the middle of September. What sort of elections (?) can be held under such conditions, where no discussion of policies, nor of the fitness of candidates, is permitted? Did anyone ever see in any free and thriving country such absolute unanimity of opinion as exists in the newspapers published in those States where Carranza is dominant at the moment? Can anyone pretend that such oppressive harmony is natural to men of spirit in any country that grants independence to its citizens?

The circular under review states that the lands are being distributed to the poor "on terms that guarantee continued cultivation of the soil and the independence of the workers." Whose lands have been thus allotted? Have any of the vast estates of General Carranza been divided up in this manner for the benefit of the poor? How did General Carranza become possessed of these lands? He may have gone through the legal forms that prevailed for the unjust acquisition of property from the poor, which is precisely what the revolution has been about. In a recent decree he very adroitly discriminated between the land grafters, classifying them according to the depth of their sin against the government! No question as to the manner in which the titles were acquired enters into consideration. Confiscation is to apply only for crimes against this government which is of Carranza's own creation! Thus has Carranza fulfilled the prophecy of those who denounced him in the beginning as a hypocrite, espousing the cause of the revolution merely to avert the confiscation of his estates. Let the facts answer!

If there be apparent bitterness in these criticisms, the reply is that some sharpness in the challenge is warranted when the Peace Committee holds out that it is in possession of the facts regarding the Mexican situation, and proceeds to address the entire press of the country in an effort to enlist its aid in spreading what, upon examination, turns out to be as hopeless a thicket of errors and misconceptions as those through which President Wilson has so long been floundering. The Friends' document, therefore, smacks of an apology for President Wilson's Mexican policy. It is not to be actually imputed against them, for no one will doubt the sincerity of the good Quakers of Philadelphia. Therefore it becomes evident that their credulity has been imposed upon by designing persons.

The Friends, moreover, are suggesting that we appropriate a sum of money from the national treasury for sending a great teaching body to Mexico, and they would have our naval program curtailed in order to provide the funds. Thus would they weaken us further, so that we and our institutions would be exposed as the easy prey of the mob, from which we have just escaped by such a humiliation of the Government as has never before been witnessed. It was by reason of military weakness that the Diaz administration went to pieces. When the mob realized the inadequacy of the army and found the lid off the good of the years of upbuilding by the great Oaxacan was swept away by anarchy. Mexico presents an example of the inevitable result of the policy of pacifism, for, though they did not call it such, they did trust too far to the good sense of the Mexican people, believing that they had so long tasted the sweets of peace and prosperity that there was no further peril of a revolution. To fully realize the enormity of the mistake made by those in authority in Mexico before the outbreak of the revolutions, one must recall the fact that the earlier of these revolutions displayed as standard bearers not the poor, the lawless, the criminal, but the public-spirited among the upper classes, the very ones whom we would have selected as sane, honest, conservative, trustworthy men, and these took up the cause, believing that they could trust the sanity of the masses and overthrow a government that had grown corrupt through too great ascendency through many decades, thereby introducing reforms in taxation, in administrative process regarding petitions to the departments for the benefit of industrial enterprises, in curtailment of the reckless granting of concessions, and at the same time reform the land laws for the welfare of the poor. Too late they found that they had uncovered the latent barbarism that lurks in all peoples, in our own as well as in others, and that there remained no governmental power to restrain the excesses of the turbulent minority among the masses, which rapidly destroyed every vestige of the old liberties which had been secured through the constructive statesmanship of three great patriots—Texada, Juarez and Diaz. It will be remembered that one of the first concerns of Madero on acceding to the Presidency was to try to create an army of 60,000 men, but there was not time. His administration was swamped before more than a beginning had been made. Armies are not called into being by rubbing an Aladdin's lamp.

When Carranza espouses the cause of the revolution to the extent of subdividing his own lands among the "herederos"—the heirs in equity under the old charters; when he dispenses with the firing squad as his great engine of pacification; when he suffers even one opposition newspaper to print and freely circulate what a genuine opposition editor honestly believes, in any important city under his actual control, it will be time for the Society of Friends to call the attention of the press of the United States to the evidence that proves it all to be true.

PROFITABLE UTILIZATION OF MUNICIPAL WASTE.

Garbage and Other Refuse Combined With Coal Slack and Water Tar Into Fuel Briquettes.

By T. J. LACY.

The factory for converting city garbage and refuse into a high-grade fuel of the Austin Oakoal Manufacturing Co., Austin, Tex., is now complete and in operation after having burned down once and after many setbacks due to the necessity of originating the machinery required for producing the new fuel bricks in a profitable manner.

The company is composed of about 40 leading men of Austin, who believe that they see a great future for this process. They are now planning the erection of a second plant because, they say, the trash and garbage collection by the carts of the city sanitary department is sufficient to keep two plants in operation.

From the standpoint of the city, the new enterprise is regarded as a fortunate development, for already the city government has experienced difficulty in finding places in which to dispose of waste without arousing the resentment of the residents of the neighborhood. The erection of a garbage-disposal plant at a cost of $75,000 or more was seen as a necessary step in the near future had the Oakoal plant proved unsuccessful. The city's contract with the Oakoal Company is that the company shall dispose of the city's refuse and garbage in a sanitary manner at a cost to the city equal to about half the cost of incineration.

The manufacture of the fuel is quite interesting, inasmuch as it is made up entirely of waste material handled by common labor. The waste, which the city had to burn formerly in the incinerator, and the garbage is taken by carts to the factory and dumped. It is then sorted and the non-combustible materials, such as iron, bottles, tin cans, etc., are segregated and sold. That which is left is placed upon a large belt and carried to a grinder which reduces it to even sizes. It is then conveyed by elevator to a storage bin at the top of the building. Coal slack, another waste product, is shipped in carloads and passed through another grinder and placed in a bin alongside the first one. The two products now come together in a mixing machine and pulper, where steam, hot water and creosote or water tar are injected, reducing the mass to a pulp.

The water tar is another waste product which the gas works usually run into the river or sewer. It contains a powerful disinfectant, and its presence makes the finished product impervious to moisture. The hot steam thoroughly sterilizes the material.

The product is now conveyed to a brick molding press, which presses the material into the shape of building brick at the rate of 40 a minute. The fuel is then placed on wooden pallets and set aside to mature and dry. In a few days it is ready for the market. The price for 1000 bricks, or one ton, is $6.50 to the customer. The chemical analysis of the University of Texas shows over 12,000 B. T. U. per pound—as much as the best Oklahoma bituminous coal. Oak wood has 8000 heat units, and consequently Oakoal is one and one-half times as strong as oak wood in heat. The new fuel is very good in heaters, fireplace grates, base burners, small boilers and ranges. It is burned successfully in bakery ovens. This fuel will be most appreciated by poor people in the cold season, when they can buy it at 1 cent a brick or less in quantities.

The perfection of the system is due to several years' experiments of E. L. Culver, formerly of Austin, but now secretary of the Co-Coal-Co., Conway Building, Chicago. Mr. Culver states that as a result of this plant several cities in the United States and Canada have adopted the system and a plant of modern construction is being erected at St. Joseph, Mo. Concessions have been granted at Flint, Mich., for one of the plants, and the Gulf Nu-Fuel Co. has about completed arrangements for plants at Columbus and Augusta Ga.

American Pipe Superior to British, Canadian or German Product.

A frank admission of the superiority of American-made pipe over that produced by British and Canadian plants was made recently in a comprehensive article in The Ironmonger of London, written by Percy G. Donald, who purchased a great quantity of three-inch and six-inch water pipe for the British Government for use in Egypt. Mr. Donald had opportunity to test under equal conditions, side by side, British, Canadian, German and American-made pipe, and admits in his article that American pipe is better packed, better threaded, that better manufacturing methods are employed and that it is more economical.

A particular feature of the American pipe was the method of packing for the protection of its threaded ends. This is contrary to the bad packing methods that many writers emphasize as one of the drawbacks in buying American goods for export, and it shows that manufacturers in this country are becoming more alert to the requirements of the trade and in handling goods for export.

Mr. Donald stated that the better protected thread of the American pipe was also superior in cut and finish, and this fact, together with the longer length used as the American standard against the shorter British pipe, resulted in a great saving of time and labor in laying the American pipe compared with the British. After the line was finished and the water pumped through, he asserted that "a large proportion of the British pipe joints leaked, but one could travel for miles along the American pipe without finding one leaking joint." The summing up by Mr. Donald makes the following strong statements in favor of American pipe:

"This is a strong indictment, but when one undertakes work such as this Egyptian pipe line, possibly the largest of its kind, and hears British sappers and engineers, after experience with British and American pipe, cry with one voice, 'give us Yankee pipe,' one feels strongly on the point."

The National Tube Co. of Pittsburgh has printed in full for distribution in this country the elaborate technical discussion of the whole subject by Mr. Donald.

BRIDGE OR TUNNELS AT NEW ORLEANS.

Public Belt Railroad Commission's Plans to Be Voted On in November.

The Public Belt Railroad Commission of New Orleans, according to a report from there, is considering plans looking to the construction of either a railroad bridge or tunnels to provide continuous tracks from one side of the Mississippi River to the other. It is proposed to vote upon a constitutional amendment at the November election, which, if carried as expected, will permit the construction in view, and, it is further stated, the commission is ready to receive suggestions as to the best method of solving the transportation problem confronting it. Mayor Behrman is president of the Public Belt Railroad, John H. Murphy acting president and F. H. Joubert secretary, treasurer and general manager. A. F. Barclay is engineer.

Hits the Nail Squarely on the Head.

THOMAS DEVLIN, President Thomas Devlin Manufacturing Co., Incorporated, Philadelphia, Pa..

I have read with great interest your article "Shall We Be Spineless and Yield Principle to Temporary Railroad Peace?" I do not know when I have read anything that sounds so good, so true and hits the nail so squarely on the head. You hold up to the public view the fact that 400,000 railroad men dictate to the President and both Houses of Congress. There is only one body, I believe, they will not be able to move, and that is the Supreme Court of the United States, and when the matter is taken there I think these 400,000 men will find the country is bigger than they.

I agree with you that men should get all that can be wisely given them, but there is a point that reaching beyond will spell ruin for the American manufacturers, because the manufacturer depends largely on the railroads and suffers indirectly through these railroad hold-ups.

I am glad you had the backbone to publish such an article.

Could Hardly Get Along Without It.

C. D. MCKINNEY, Green, Tilson & McKinney, Attorneys, Atlanta, Ga.

No periodical coming to my home office is read with more interest or is more appreciated than the MANUFACTURERS RECORD, and I would hardly know how to get along without it.

GARBAGE AND TRASH BEFORE TREATMENT.

"OAKOAL" BRICKS FROM MUNICIPAL WASTE.

800,000 Acres of Texas Land Sold for $4,000,000—Mineral Rights Reserved.

A sale of 800,000 acres of land located in 12 Texas counties has been made by the Houston Oil Co. to the Southwestern Settlement & Development Co. The purchasers plan a development of this property for agriculture by dividing it into farms for colonization. The officers of the Southwestern Settlement & Development Co. include Edward Whitaker, vice-president of Boatmen's Bank of St. Louis; Murray Carlton, president of Carlton Dry Goods Co., St. Louis; Sidney H. March of Ladenburg, Thalmann & Co., New York; Charles D. Saunders of Boston, and Edwin G. Baetjer, Louis S. Zimmerman and Henry J. Bowdoin of Baltimore.

The aggregate price at which the property is taken over by the purchasers is $4,000,000, or at the rate of about $5 per acre, the Houston Oil Co. reserving all mineral rights. The payment for the property is to be made out of the proceeds of the sales of land.

This is probably the largest sale of land intended for agricultural development made in the South since the sale, many years ago, of 3,000,000 acres by the State of Texas to the Farwell Syndicate of Chicago, which accepted from the State 3,000,000 acres of land in payment for the building of the magnificent capitol at Austin.

Million-Dollar Hotel Proposed for Sarasota Bay.

Jacksonville, Fla., September 8—[Special.]—That the West Coast of Florida is fast becoming the mecca for wealthy winter residents is shown by the statement of Franklin H. Hough, a prominent attorney of Washington, D. C., while in Jacksonville recently, that capital had been raised in New York for the erection of a million-dollar hotel at Sarasota, work on which would be started immediately.

Mr. Hough stated that he was unable to divulge the names of those interested in the project, but that his brother, A. P. Hough, also of Washington, and who owns a large winter estate at Sarasota, is among them.

Mrs. Potter Palmer has a home near Sarasota.

Who Constitute the Lawless Element?

Editor Manufacturers Record:

I read with much interest two articles in a recent issue of your paper, in which the writer undertakes to lay the blame for lynching upon the innate meanness of the people. He misses the mark entirely, just as every writer upon this subject has heretofore done. No citizen, whether he has a poll tax receipt or not, wants to lynch a person just as a matter of fun. The people of the South are patient and long-suffering people, and they have suffered more to the square mile than people of any other section of our great and common country. They are patient to an immeasurable fault, as the records of our courts will abundantly prove if such records are examined.

The courts of the country are wholly responsible for the lynching industry in the South. Duck and dodge the question as we may, the inevitable fact remains true. It is not necessary to attempt to argue that the practice of the courts is so rotten that every citizen, of high or low degree, has lost absolutely all respect for the courts, because they know that therein justice has long since ceased to be a known quantity, and there today ranks injustice and farce long drawn out, under the guise of law, is the rule and not the exception. If proper attention were given to seeing that the lawyers for the defense in every criminal case were held to reason, shorn of every shred of foolish technicality and delay, lynching would fail and we should hear no more about it. Our criminal laws are so shaped that practically no end is permitted to delay, technicality and shysterism to defeat the ends of justice by the lawyers in charge of any given case, and the judge on the bench, under the law, is powerless to prevent it. Should he object, a score of exceptions would at once be filed, and on appeal the case would be remanded for another trial.

In Texas, every chance under the sun is thrown around the criminal and every hindrance possible is thrown in the path of the State in its attempt to convict him of crime. The result is that lawyers of secondary legal ability are generally elected to the position of States Attorneys, and they are bullragged to a finish by the attorneys for the defense. Just as a sample of our Texas justice, I give this illustration:

Ten years ago, in a certain east Texas county, a man shot and killed, in cold blood, another man who had dismounted from his horse and was walking towards a store. A brother of the murdered man ran to his assistance and he was also shot and killed by the man who had slain his brother. The murderer was arrested, indicted and in due time came to trial. The case was continued by the defense, although every witness had been summoned and was ready. Six months later the case again came on for trial and on motion of the defense the venue was changed to another county. Six months later it again came up, and after many objections went to trial. The jury, after hearing volumes of important testimony thrown out of court, and practically every man and women for the State made out a liar and reprobate, brought in a verdict of guilty and assessed punishment at ten years in the penitentiary. The case was appealed. It lay in the Court of Appeals one year and was reversed on a technicality, that technicality being that one of the jurors had read an account of the trial in a daily paper while the case was in progress. It came back to the district court and again the venue was changed to another and distant county, and the case continued another six months. In the meantime, two of the most important witnesses of the State had died, and the widow of one of the murdered men had married a particular friend of the man charged with the killing. Finally, the case again came to trial and the man charged with murder was given five years. On another technicality the case was appealed and went to the Court of Appeals, where it lay for another year and was again reversed and sent back to the lower court for retrial. It was again continued twice in succession and when it again came on for trial and could not be continued, it took a change of venue to the district court of a county 150 miles from the county in which the killing occurred. It has been there one year and will be called for trial at the next term of court. To that court, 150 miles away, men and women will have to go, losing time and suffering great inconveniences. The man who killed the two men has never been in jail a moment, but on the contrary, is a member of the official force in one of the large Texas cities.

Think of that and then wonder why lynching obtains sometimes in the Lone Star State! Ten years, and still dragging through court! In your articles you lay no blame whatever at the door of the lawyers of this country. They and they alone are responsible for the life of every man who has been lynched in the South in the past fifty years, in cases where a charge of crime could be laid in a legal way.

Here is a more recent case: Jake Giles, sheriff of Jefferson county, Texas, went to Kansas City, Mo., to bring back a man and woman who were charged with minor offenses at Beaumont. Giles got his prisoners, but being a kind-harted man, permitted them to accompany him on the train as fellow travelers, instead of chained and handcuffed criminals, as they should have been. The train rolled southward. In the darkness of the night, when near Muscogee, Okla., the woman rose, slipped up behind the sheriff, who had gone to sleep, and with a pistol, deliberately blew his brains out. She and her husband then went through the murdered sheriff, took his pistol and money and then with drawn pistols forced the officials of the train to stop it. They left it, but were captured the following day and placed in jail at Muscogee, where they were given bouquets and showered with attention. The trial came on, but in the meantime this same man and woman had made a murderous assault on the keeper of the prison and he narrowly missed being killed. The State appointed two lawyers to defend the man and woman. They proved that the woman was crazy and brought in a verdict of acquital. They sent her husband to the penitentiary for 99 years, although he did not fire the shot that killed the sheriff. Then they turned around and sent the alleged crazy woman to the penitentiary for ten years for attempting to kill the jailer, and because she had been adjudged insane, the attorneys came very near having her turned loose altogether. They are both in the Oklahoma penitentiary now, but there is not a particle of doubt that they will be pardoned out before they are there five years. And then you go and deliver a lecture on lynch law, and why it exists in the South, without a single justifiable cause!

In Texas we had passed, for the especial benefit of the murderer and other classes of criminals, the Pardon Law and the Suspended Law. Under the first no man hardly ever stays in our State penitentiary more than five years, although sent up for life, while under the latter, while the jury may bring in a verdict of guilty of murder and assess the punishment at five years, the trial judge has the right to suspend the sentence and turn the man loose. During the past year thousands of criminals have thus escaped justice in the Lone Star State, and many have left the State. Do you call this justice? Is it right? Still another law in favor of the criminal here in Texas is the law which permits a criminal to give bond while waiting for his case to be determined by the Court of Appeals. In this way hundreds have escaped when they learned that their cases had been reversed and sent back for re-trial.

If the Manufacturers Record, through its vast agency of reaching and affecting the popular pulse, will tackle the courts of the country and hold up their practice to the contempt of civilization, the time will come when lynching will perish from the earth. Delay and technicality, unreasonable, unjust and unrighteous, are what ails the courts of this country, and the lawyer, it matters not how high he may stand in the estimation of his fellow-citizens, who deliberately, through maze and technicality, seeks to set free and does set free the red-handed murderer, is more to blame than the man who goes forth at night with a mask on his face and helps at a lynching bee. When we as a people become educated to this point, civilization will have taken a long stride forward.

HENRY C. FULLER.

Houston, Tex.

[Mr. Fuller has not stated the case against shyster lawyers and the courts which have permitted shyster lawyers to defeat justice more strongly than the MANUFACTURERS RECORD would do. We repeat what we have said many times; the legal fraternity is cursed with men whose business it is to obstruct justice, with men who make their living and who hope to secure prominence by knowingly fighting to save criminals and to defeat the ends of justice.

The honest lawyer can defend his client, even though he believes him guilty, up to a certain point, but when, through the connivance of the courts and the legal machinery of the State, it becomes possible to defeat all justice and to turn criminals loose upon the public, the lawyer who is a party to this should himself be classed as equally guilty with the criminal. He should be outlawed by all respectable society and no man who honors virtue or upholds the right, should be willing to be seen with or associate with a lawyer who, by these criminal technicalities, brings about such conditions as those stated in Mr. Fuller's letter.

Nevertheless, while all this is true, and while this is one of the problems that the country must face and overcome, it does not wholly explain lynching nor does it at all justify it. If the people of the South would make up their minds to free their section from the curse of these criminal delays in the courts, and what ought to be called the criminal acts of lawyers in defeating justice, they could do so. If there were any excuse whatever for lynching, the men lynched should be the lawyers responsible for the conditions outlined by Mr. Fuller, but even a condition as serious as that presented by him does not justify lynching. It does, however, justify and demand that the entire judicial machinery of the States where such things exist shall be overturned by the power of an aroused public sentiment.

Wherever it can be truthfully said that conditions such as Mr. Fuller has outlined are permitted to exist, there is rottenness; rottenness in the courts, in the legal fraternity and rottenness in public opinion that does not overturn such conditions and build up an honest judiciary. The MANUFACTURERS RECORD knows only too well that much of what Mr. Fuller says is true; it is true in other parts of the country as well as in the South, but it does not produce lynching elsewhere to the same extent as in the South. We are suffering from the rottenness of politics, and if that part of the whole political element of the country—judges, juries, sheriffs, and all others who are, in any way, responsible for this condition—could be forever banished to some distant island of the sea, the country, and the South especially, would breathe a newer and cleaner and purer and sweeter atmosphere of business and social life.—Editor MANUFACTURERS RECORD.]

Condemnation Heartily Approved Of.

J. S. BONE, Oconee Brick & Tile Co., Milledgeville, Ga.

We heartily approve of the editorial in the MANUFACTURERS RECORD condemning the action of our Government in setting aside the great principle of arbitration and allowing a few workmen to dominate the nation. They demand more pay when they are now the best paid people on earth.

What has become of our great daily papers, which mold the opinions of the people? Why are they so painfully silent at this critical time when the people should be informed of the true conditions of affairs? Why don't they take a stand for equity and justice, which this Government claims to stand for?

Coal Mining Machinery, Etc.

Compania de Importacion, No. 2 Langreo, Gijon, Spain:

"We are interested in small machinery and equipment for exploiting and mining coal on a small scale, in miners' safety lamps, etc.; also in lubricating oils, automobiles, typewriting machines and coal."

Cotton the South's Great Industrial Preparedness Asset and Its Relation to World Affairs.

By MARTIN L. GRIFFIN, Associate Member of Naval Consulting Board, Rumford, Maine.

REGARDING the industrial potentialities of our Southern States as an asset for national preparedness, I am pleased to refer to one most notable resource and to emphasize its importance, leaving it to others to make prominent other resources and products whose exploration, discovery and development have been spectacular in many instances. Of all the South's resources, cotton is King. There the soil, climate and people unite to produce a crop whose products, with the aid of the gin, the loom and the chemist, are the most varied, numerous, useful and valuable of all the products of the soil or the mines. The world depends upon the South as its principal source of cotton. During the year 1915 the value of the raw cotton crop amounted to $794,000,000, and the direct products of the seed $166,000,000 more.

Cotton occupies a position of such pre-eminent international importance that it enjoys a commercial exchange of its own, where its sales are a matter of daily record. No article of commerce plays a more important part in the great European crisis than cotton, not even powder and shot. When the embargo on cotton to the Central Powers was made effective by Great Britain, and our market was thereby greatly curtailed, so popular is cotton that the slogan was "Buy a bale of Cotton."

In the entire life history of cotton and the cotton plant the chemist has played a most important part. He has studied the soils and fertilizers, the methods of culture and climatic environment to produce the best types of fibers; he has fought the cotton-boll weevil and worm, and resorted to every means to produce the strongest, longest and finest product.

Cotton furnishes the raw material for our greatest textile industry, supplying a thousand of our most important necessities. Cotton fabrics not only furnish the material for clothing mankind, but are indispensable in the manufacture of automobile tires, high-pressure hose, belting for power transmission, and countless other commodities.

John Mercer, the English dyer and chemist, while searching for improvements in processes for dyeing cotton goods, discovered also, in 1850, a process which bears his name for giving a silky luster to fine cotton fabrics. Without doubt these discoveries have furnished an impetus to the great industry in aniline dyes.

Another striking process and very important product from cotton is artificial silk, first produced by the French chemist, De Chardonnet.

I can but mention by name other products of the greatest commercial importance: The cellulose nitrates and acetates from which varnishes, films for photographic and other purposes, explosives and artificial leather are made.

In the ginnery the chemist found the cottonseed, from which he first removed the lint and then the hull, which he discovered to be a valuable cattle food. From the kernel he pressed out one of the most valuable oils of commerce, leaving a rich meal for mixture with the ground hulls. He purified the oil, separated the stearin to make a substitute for lard, he hardened and sweetened the oil to the consistency of butter as a substitute for butter for many domestic uses. He has made soap and glycerine from it. Finally, from the cast-off rags and refuse stalks he has made paper, and there is no dream about any one of these achievements.

Cotton is a high-priced raw material whose value is immensely enhanced by the loom. I know of no important industry where such great values are created by labor. It does not depend upon other material resources in its transition to these higher values. In the finest fabrics it is still cotton only. It is a self-contained and independent industry.

Until recent years the raw cotton of the South has been shipped away and exported for manufacture, furnishing labor and creating wealth for others. Here lies one of the greatest industrial opportunities any people or nation could covet. What greater industrial preparedness asset could any nation possess than the South with climate, soil and people adapted to the growth of cotton and every facility at hand for its manufacture into products so capable of sustaining mankind? It is an industry which neither depletes nor impoverishes any natural resource; neither does it thrive at the expense of any other. It is a builder of great and prosperous cities and communities.

YELLOW PINE WASTE BASIS FOR GREATEST CORRELATED BY-PRODUCT INDUSTRIES WORLD HAS EVER KNOWN.

As I have repeatedly pointed out, only about one-third of the average yellow pine tree reaches the market as a merchantable product. Two-thirds of the tree is wasted, either as field waste or mill waste, in the best present practice. For 15,000,000,000 feet board measure that goes to market annually, 30,000,000,000 feet are wasted. It is a staggering total. It may be said at once, without fear of successful contradiction, that the potential profits in this waste are far greater than any actual profits which this branch of the lumber industry can be made to yield from lumber. When this waste is intelligently considered, not as waste, but as raw material, it will be seen to afford a basis for building up the greatest group of correlated by-product industries the world has ever seen. The products of these industries will comprise wood pulp, pulp boards, paper, paper bags, paper twine, turpentine, rosin, pine oil, charcoal, tar, ethyl alcohol, cattle feed, varnishes, ether and not improbably acetic acid, wood alcohol, acetone and producer gas.—Dr. Arthur C. Little, Former President American Chemical Society.

EXCEPTIONAL NATURAL ADVANTAGES.

For years the hearts of the people of the South have been warmed by contemplation of the exceptional natural advantages of their great section; their ambitions have been stirred, and the flame of their hopes for industrial development kept burning. However, nothing commensurate with the wonderful natural advantages has been actually accomplished.—Frank S. Washburn, President American Cyanamid Co., Niagara Falls, Canada.

THE SOUTH COULD DUPLICATE NIAGARA'S INDUSTRIES.

I think it may also be well to remember that the industries grouped around Niagara Falls, now strangling for want of more power, are as much the result of the power plants installed there as they were the cause of those plants. These industries came into existence because electric power was made cheaply available there.—Dr. W. R. Whitney, Research Laboratory, General Electric Co., Schenectady, N. Y.

LIMITLESS POSSIBILITIES AHEAD.

It is difficult within the limits of a brief article to cover the whole field of industrial possibility which awaits the application of science to industry in the South. Enough has been said to show the almost limitless possibilities which lie ahead.—Allerton S. Cushman, Ph.D., Director Institute of Industrial Research, Washington, D. C.

RICHEST ON GLOBE.

The mountain section stretching from the break at the Potomac River to the Alabama border probably contains a greater variety of mineral wealth than any other section of the globe.—Dr. John C. Hebden, Vice-President and General Manager Federal Dyestuff & Chemical Corporation, Kingsport, Tenn.

IDEAL CONDITIONS.

The conditions for establishing manufacturing enterprises in the South are therefore ideal for the economic development of this great section.—Dr. John C. Hebden, Vice-President and General Manager Federal Dyestuff & Chemical Corporation, Kingsport, Tenn.

TEXTILES

$600,000 Additional Cotton Factory.

Plans and specifications have been accepted for the additional mill recently announced as to be built by the Mooresville (N. C.) Cotton Mills, in connection with that company's increase of capital from $400,000 to $1,000,000. W. H. Rose of Goldsboro, N. C., has contract for constructing the buildings, the principal structures being a one-story 410x127-foot spinning mill and a 420x137-foot weaving mill. These will be equipped with 10,000 spindles and accompanying twisters, looms, etc., all of the machinery having been purchased. The company has awarded contract to Ralph M. Brawley of Mooresville to build 40 tenement cottages for the mill operatives who will be needed.

$50,000 Cotton Specialties Mill.

Cotton specialties of various kinds will be manufactured by the Pope Manufacturing Co., R. P. Pope, president, Mobile, Ala., which was recently incorporated with $50,000 capital. Plans and specifications have been accepted for the mill building, a one-story brick structure having 13,000 square feet of floor space, to cost $10,000. E. J. Raub & Co. have the contract and Wetzel & March are the architects.

$100,000 Hosiery Knitting Enterprise.

The Olive Hosiery Knitting Co., Shelby, N. C., has been incorporated by S. S. Royster, D. W. Royster and H. R. Royster. Its capital is $100,000.

Textile Notes.

The recent report that Chas. W. Johnston, president of the Highland Park Manufacturing Co., Charlotte, and associates will build a $1,000,000 cotton mill was entirely erroneous.

F. D. Spencer, 1814 Winthrop avenue, Charlotte, N. C., may establish a mill for manufacturing absorbent cotton and gauze. He wants data and prices on the necessary machinery.

The January & Wood Company, Maysville, Ky., mentioned in August as incorporated with $200,000, manufactures woolen goods. It was established in 1851, incorporated in 1888 with $200,000 capital and reincorporated this year with the same capitalization. Extensive improvements begun last year are nearing completion.

E. L. Shuford, Hickory, N. C., lately noted to build a hosiery mill, will organize a company and establish the mill at Brookford, N. C. The capitalization will be $10,000 and the machinery will include 12 knitters, 7 loopers, 18 ribbers, etc., with daily capacity of 150 pairs of hosiery. A three-story 50x40-foot brick building has been secured.

Will Spread the Doctrine.

C. D. GARRETSON, President The Wilmington Employers' Association, Wilmington, Del.

You have put the matter very fairly, very forcibly, and very fearlessly. It appeals to me so strongly that I would ask you to send me twenty-five copies of this bulletin, that I may send them to the members of this association.

The Iron, Steel and Metal Trades

STEEL SUPPLY BECOMING SCARCE.

Allies Purchasing Steel Discards—Navy Department Soon to Enter Market—Sheet Market Stiffens—Inquiry for Unfinished Steel Subsides—Pig-Iron Continues Active.

New York, September 11—[Special.]—The increasing scarcity of steel for early delivery was exemplified in the order placed at the end of last week by representatives of the Entente Powers for 100,000 tons of shell steel discards. This business was placed by two Middle Western steel manufacturers, who report that this tonnage had been previously rejected, and that the Allies are also endeavoring to purchase other stocks of discards. It is interesting to note in this connection that in the early days of the European war the allied governments rigidly adhered to the unusual specifications that they submitted to the mills, and caused extensive rejections for slight imperfections. At that time the Allies demanded the cutting off of a considerable portion of each ingot to avoid piping, segregation and other defects. Now the situation has developed where steel formerly rejected, as well as crop ends, are being purchased by the belligerent nations.

The demand for shell steel from domestic sources continues to be very brisk. One industrial concern is in the market for 45,000 tons of steel bars, while other shell makers are in the market for round tonnages.

Trade factors are interested in the announcement that early next month the Bureau of Supplies of the Navy Department will enter the steel market for 5879 tons of plates, 550 tons of angles, 210 tons of I-beams and 115 tons of steel castings for the Boston, Norfolk and Philadelphia navy-yards. This is considered the forerunner of what the Navy Department will require in connection with its preparedness program. The problem of supplying the Navy Department with steel will probably be solved by several of the mills holding themselves in readiness to accept and take care of this business.

There was a temporary lull last week in the domestic steel situation, due to the threatened railroad strike, as its accomplishment would eventually have meant the shutting down of various plants, temporarily at least. Some slight congestions were caused by the embargos that were placed last week by the railroads, but the amount of tonnage tied up was small. As the threat that there would be a railroad strike did not affect the various branches of the steel and iron industry to any marked extent, the fact that now there is to be no strike is not likely to have any influence. Steel market conditions have not changed to any appreciable extent from that reported in these columns in the two previous weeks.

The market for black sheets stiffened somewhat during the past few days. On ordinary orders 2.90 cents now appears to be the minimum price, while 3 cents is frequently done on regular open-hearth stock. The mills are preparing for an advance in price of black sheets, as they will soon be in the period in which sheet bars will cost considerably more money than they do at present. Within a few weeks orders will be taken for the first quarter or first half of next year, and in view of the high price of steel, with no signs of the scarcity being relieved, it is expected that the market will be on a basis of 3.25 cents for contracts commencing January 1.

The blue annealed sheet market continues active, with quotations still held at 2.90 cents for Bessemer and 3 cents for open-hearth. There has been some shading of late by manufacturers below 2.90 cents, but the sheets were of inferior quality and the specifications were confined to certain gauges and sizes.

The demand for unfinished steel products fell off slightly last week, and is now confined to light proportions. Whether this condition is due to the requirements being light or to possible buyers realizing that there is scarcely any use in inquiring it is difficult to state. Deliveries on contracts, however, continue to be of a satisfactory volume, so that purchasers at this time would only be those who were not provided with contracts.

An expected advance in the price of tinplate is looked for within the next week or so. The earliest date at which a price for tinplate was made for the next year's season was on September 5, 1912, so that no record will be broken by a price being made at this time. It is not believed that the new price, whenever it is made, will be below $5.50, which is the present minimum of the market for this product, with $6 more frequently quoted. The average price of tinplate for the past five years has been $3.44; the average price of pig-tin for the same period was 40.26 cents, while the average market on sheet bars was $22.25. Assuming that tin will be 40 cents on the date the new price of tinplate is to be announced, there should be no change on this score.

The domestic demand for pig-iron for requirements over the first half of next year continues to be manifested. Domestic melters have been watching the increased foreign absorption of foundry grades, and this avenue of business is now forming the basis for the opinion that higher prices for pig-iron are inevitable. Consumption of foundry iron in this country has been going on at a very rapid pace, and the fact that foreign buyers are pressing negotiations for iron has served to place sellers in a position to ask higher prices, and these may be forthcoming shortly.

The foreign demand for pig-iron goes on at a good steady pace, with Italy now the principal factor in the movement. In the West business continues very brisk. The Standard Sanitary Manufacturing Co. is in the market for 6000 tons of foundry iron, while the American Locomotive Co. has just closed a contract for 5000 tons for its Schenectady and Dunkirk plants. The Republic Iron & Steel Co. is said to be negotiating for a block of steel-making iron, and another large steel mill is also reported to be in the market.

While considerable Bessemer and basic was involved in the renewed pig-iron buying in August, yet the combined effect of these sales was not to increase the quotation on these grades. The average actual sale price of basic iron last month was $18 Valley, which was unchanged from July and June. The price of Bessemer iron in August was $21 Valley, as compared with $21 in both June and July.

A general advance in the price of standard steel pipe, line pipe, oil country goods and boiler tubes was announced by the National Tube Co. on Thursday. No advance was made in galvanized pipe. In standard steel pipe there was an advance of one point on all butt weld sizes, while lap weld was advanced two points on 12-inch sizes and less. Line pipe of corresponding sizes is advanced by the same amounts. Oil country goods have advanced about $4 a ton. Boiler tubes are advanced two points on all sizes. The basing discount on standard steel pipe, ¾ to 3 inch, is now 79 per cent., while steel boiler tubes, 3½ to 4½ inch, are 54 per cent.

The advance in pipe is predicated upon the high prices for billets and plates, and even at the advances tubular goods are much below their parity. The mills are much more oversold on lap weld sizes of steel pipe than on butt weld sizes; hence the larger advance on the former. Some of the independent mills have lately been quoting as high as six points above the National Tube Co.'s card on some lap weld sizes.

STEEL AND IRON PRICE CHANGES.

(Dealers' average buying prices for gross tons.)

Bessemer billets (nominal)	$45.00—$50.00
Open-hearth billets (nominal)	45.00— 50.00
Open-hearth sheet bars	45.00— 50.00
Bessemer sheet bars (nominal)	45.00— 50.00
Forging billets	65.00— 70.00
Wire rods	55.00— 60.00
Muck bars	40.00— 45.00
Beams	2.60— 3.00
Tank plates	3.00— 3.75
Steel bars	2.60—
Common iron bars	2.60—
Rails	47.00— 48.00
Steel hoops	3.00—
Cold-rolled strip steel	6.00— 6.50
Sheets, No. 28 gauge	2.90—
Galvanized sheets	4.25—
Wire nails, No. 28	2.60—
Cut nails	2.60—
Plain fence wire, base	2.55— 2.65
Barb wire, galvanized	3.45—
Railroad spikes	2.65—

Pig-Iron.

Bessemer, Pittsburgh	21.95— 22.45
No. 2 foundry	19.45—
Basic, valley	18.95— 19.20
Gray forge	18.95—
Basic, Philadelphia	19.50— 20.00
No. 2 foundry, Northern	19.50— 20.00
Low phosphorus	34.00— 35.00
No. 2 foundry, Buffalo	18.00— 18.50
No. 2 South, Cincinnati	16.90— 17.40
Basic, del., Eastern Pennsylvania	19.50—
Bessemer, Cleveland	21.00—
Northern foundry, No. 2, Cleveland	18.50— 18.75
Gray forge, valley	18.00—

FOREIGN AND DOMESTIC IRON ORDERS INCREASING.

Anniston Electric Steel and Ordnance Plants Busy.

Birmingham, Ala., September 9—[Special.]—The real feature of the Birmingham pig-iron market the past week was the exceptionally heavy demand for export iron. While there was considerable iron sold for export shipment, the final bookings will depend on available bottoms. Export iron is in heavy demand from the Scandinavian countries, and from Holland, France, Spain and Italy. The general specifications cover the bulk of iron, while some good round lots call for special analysis iron. The total tonnage booked in the district the past week ranges from 25,000 to 30,000 tons, and prices obtained from $14.50 to $15 per ton f. o. b. cars at the furnace. Lower prices than above figures have gradually disappeared, and the generally recognized base price has centered around those figures for prompt, balance of the year and first half of 1917 delivery. While the August production figures show an increase over July of a little over 4000 tons of iron, yet there was a decrease in foundry iron and increase in basic, and September figures will show a still further increase in basic and decline in foundry by reason of the Woodward Iron Co. having taken one of its large stacks off foundry iron and put it on basic iron for the balance of the present year. This feature will add strength to foundry iron by reason of decrease in production. In addition to heavy demand for export iron, there has also been a corresponding heavy demand for domestic shipment, there having been sold between 20,000 and 25,000 tons on the basis of $14.50 to $15 per ton at the furnace. There have been several inquiries received from the large pipe interests, which indicates that these large buyers realize that probably the market's tendency is to firmly crystallize around the above base price, with prospects of an early advance. Outside the pipe interests, as far as Southern foundries are concerned, the general trade has been well taken care of for the balance of this year. However, inquiries for next year shipments are receiving the attention of buyers. There have been some sales made through the first quarter of 1917 on the basis of $14.50 per ton at the furnace, but the general quoting price seems to be $15 through the first half.

The steel interests of the district are running to their present full capacity, and it is more a matter of accommodation on their part that additional orders are received.

The electric steel plant of the Alabama Properties Co., located at Anniston, Ala., has sold its output of steel products for the balance of this year, and is installing two additional six-ton Heroult furnaces. The Anniston Ordnance Co., which has been operating night and day on its steel shell contract, has negotiated an additional sale of 65,000 shells for foreign shipment.

The cast-iron pipe manufacturers of the district report that a gradual improvement has taken place along with the revival in pig-iron, and that prospects for further immediate improvement are good. Orders in hand are sufficient to keep all plants steadily employed in getting out their product on a good percentage basis. The suspension of the proposed increase in pipe rates to the Pacific coast has had a marked effect for the betterment of conditions. Prices are firm and unchanged, being as follows per net ton f. o. b. cars yards for high-pressure pipe: Four-inch, $28; six-inch and up, $25, with $1 per ton extra for gaspipe and 16-foot lengths.

The coal operators of the district report that general conditions are good, but that the most serious feature being faced is that of shortage of equipment in which to move material. Operators are being threatened with cancellation of certain orders if prompt relief is not given, and those buyers who are located near enough to the Tennessee and Kentucky fields express a willingness to try for relief from those sections.

The steamboat Volcano of the Debardeleben Coal Co. sank in the Warrior River 175 miles south of Tusca-

loosa during the week, and has had to look to the Alabama-New Orleans Transportation Co. for river equipment. The boat will be recovered and ready for service within a few weeks. The Hammond-Byrd Iron Co., sales agent for the Imperial Coal & Coke Co., has called upon Congressman Huddleston for service in the matter of revised Government coal specifications for Panama. Heretofore these specifications have been so prescribed in their limits as to preclude all coal except that from a restricted area. It is a more general specification that they are asking for. The coke situation continues at maximum tension, and prices well maintained, being $3 to $3.25 per ton at the ovens for furnace and smelter coke and $4 to $4.50 per ton for foundry coke.

Dealers in old material report that there has been an exceptionally good demand for their product—all lines of scrap. Heavy stocks are being taken on, and the sales to the Middle West of all grades have been brisk. The home consumption for steel and wrought scrap has also improved. With the increased output of the steel plant at Anniston in contemplation, there will be an increased demand for home consumption in steel scrap.

Following are producers' and dealers' prices per gross ton f. o. b. cars Birmingham:

PIG-IRON.

No. 1 foundry and soft	$15.00 to $15.50
No. 2 foundry and soft	14.50 to 15.00
No. 3 foundry	14.00 to 14.50
No. 4 foundry	13.75 to 14.00
Gray forge	13.50 to 13.75
Basic	14.50 to 15.00
Charcoal	22.00 to 22.50

OLD MATERIAL.

Old steel axles (net ton)	$25.00 to $26.00
Old steel rails	11.50 to 12.00
No. 1 wrought	13.00 to 14.00
Heavy melting steel	10.50 to 10.75
No. 1 machinery	10.50 to 11.00
Car wheels	10.50 to 11.00
Tram car wheels	10.00 to 10.50
Stove plate	8.50 to 9.00

The Tennessee Company has resumed the manufacture of ferro-manganese at one of its Bessemer furnaces. Shipments of ore will be from Brazil, together with high-grade manganese ore from the Cushman, Ark., fields.

A. L. Connors has been appointed general manager of the steel plant of the Gulf States Steel Co., Gadsden, succeeding C. A. Moffett, who some time ago was elected vice-president and manager of all operations.

C. J. Barr, who has been general superintendent of the steel plant of the Tennessee Company at Ensley for several years, has resigned. Mr. Barr will be succeeded by W. G. Mathias, who was formerly assistant superintendent.

COPPER STILL IN DEMAND.

Large Inquiries for the Red Metal for First Half Reported—Spelter Market Firm—Lead and Tin Dull and Quiet.

New York, September 11—[Special.]—The chief development in the copper market last week was the announcement of a large inquiry for the metal coming from the Russian Ministry of Munitions. It was stated that the inquiry called for 10,000,000 pounds, and the business was to be placed at once. The last Russian copper order was placed abroad, but the filing of the inquiry with producers on this side indicates that the metal will be taken from American sellers. Domestic demand continues steady, with some producers reporting inquiries for round lots for the first half of next year. Nearby metal is not as much in demand as formerly, and some sellers are inclined to make concessions, but the forward market is well in control of producers.

Conditions in the lead market were practically unchanged from those reported last week. Despite the inactivity, however, the market held fairly steady. The well-sold-up condition of the independents enables them to maintain prices, while the leading interest is also booked full and is not taking any outside orders. Some consumers are in the market for October delivery, but the independents have not settled on a price.

Large sales of spelter were made for delivery over the next six months at the end of last week, and the latest transactions were closed on the basis of 8½ cents East St. Louis for the fourth quarter and 8¼ cents for the first quarter of next year, an advance of ⅛ cent over the prices previously paid. There is also a better demand for future deliveries. The buying has come chiefly from brass manufacturers and is said to have been against some new contracts which have been placed for brass rods. Sheet galvanizers have also been buyers of late for both October and November delivery.

The market for tin continues to be very quiet, althought the tone is holding quite steady. Sellers report that consumers who had been previously sounding the market for futures are no longer interested. The situation reflects the well-covered position of buyers and the determination of spot holders to refrain from liquidating until prices recover. Tin arrivals from the first of the month are 560 tons, and stocks afloat are 3980 tons.

THE WEEK'S PRICES.

	Copper. Lake.	Copper. Electrolytic.	Lead. A. S. & R. Co.	Lead. Ind.	Spelter.	Tin.
September 4	*	*	*	*	*	*
September 5	27.00—27.50	27.50—28.00	6.50†	6.65	8.80	39.00
September 6	27.00—27.50	27.50—28.00	6.50†	6.50—6.65	8.80	39.00
September 7	27.00—27.50	27.75—28.00	6.50†	6.60	8.80—8.92½	38.90
September 8	27.00—27.50	27.75—28.00	6.50†	6.60	8.80—8.92½	39.00

*No market. †Nominal.

Good Roads and Streets

SOUTHERN HIGHWAY ACTIVITIES.

Details in regard to road and street undertakings and bond issues, briefly mentioned below, are given under the proper headings in our "Construction Department" and "New Securities," published elsewhere in this issue.

Bonds Voted.

Charleston, W. Va.—Kanawha county voted $90,000 bonds to construct roads.

Coffeeville, Miss.—Yalobusha county voted $100,000 bonds to improve roads.

Covington, Va.—Alleghany county voted $100,000 bonds to construct roads.

Fayetteville, W. Va.—Fayette county issued $950,000 bonds for road construction.

Hartville, Mo.—Wright county voted $40,000 bonds to construct roads.

Redwater, Tex.—Redwater precinct voted $25,000 bonds for road construction.

Bonds to Be Voted.

Fayetteville, Tenn.—Lincoln county votes October 7 on $450,000 bonds for road construction.

Greenville, S. C.—City votes September 26 on $65,000 bonds to pave streets.

Macclenny, Fla.—Baker county will vote on $60,000 bonds to construct roads.

Morganton, N. C.—Bruce county votes October 14 on $20,000 bonds to construct roads.

Contracts Awarded.

Chapel Hill, Tenn.—Turnpike county awarded contract for six miles of road.

Charleston, W. Va.—Kanawha county awarded $100,000 contract to construct 3½ to 5 miles of road.

Covington, Ky.—Kenton county awarded $22,000 contract to improve four miles of road.

Henderson, Ky.—Henderson county awarded contract for 3¼ miles of macadam road construction; $24,000 available.

Joplin, Mo.—City awarded $4394.16 paving contract.

Lexington, Miss.—Holmes county awarded $145,000 contract to construct 40 miles of gravel roads.

Wayne, W. Va.—Wayne county awarded $22,500 contract for road construction.

Contracts to Be Awarded.

Asheville, N. C.—City will improve 28 streets.

Amarillo, Tex.—City will pave 50 additional streets.

Baltimore, Md.—State receives bids until September 26 for five miles of road construction.

Blackwell, Okla.—City will construct vertical fiber vitrified brick paving on concrete base; cost about $40,000.

Clinton, Okla.—City will pave about 15 blocks in business district; cost about $80,000.

Gadsden, Ala.—City will construct 2200 square yards of sidewalks and curbs and gutters.

Grenada, Miss.—Grenada county will construct 50 miles of sand-clay roads.

Lenoir, N. C.—L. P. Henkel and others will construct 22 miles of road; cost $150,000.

Little Rock, Ark.—City will improve 50 blocks asphalt macadam street construction, with concrete curb and sidewalks; $52,000 available.

Sand Springs, Okla.—City will construct asphaltic concrete pavement; cost $110,000.

Vernon, Ala.—Lamar county will construct 15 miles of road.

Extension of Florida Good Roads System.

Jacksonville, Fla., September 9—[Special.]—As pointed out by F. O. Miller, member Florida State Highway Commission, the decision of the County Commissioners of Baker county, Florida, to call an election to vote on a bond issue of $60,000 for good roads indicates that a proper co-operative spirit exists between the local authorities and the Federal good-road department.

At a recent meeting of the State Highway Department, Florida's part of the Government appropriation, totaling $56,000, was prorated among the counties needing the road improvement most, and Baker county was given $14,000 of this sum, the county to raise a similar amount. The entire State Highway Board held a conference with the County Commissioners of Baker county September 4, when the importance of raising a sum to meet the Government appropriation was impresed upon the commissioners. The decision to call an election to vote on a $60,000 good-roads bond issue resulted.

The $28,000 derived from the Federal department and county jointly will complete an important link in the Old Spanish Trail Highway between Miami, Jacksonville and Pensacola, and the $46,000 remaining will be spent in building important arteries connecting with the main highway at Glen St. Marie.

Motorists who tour the South annually and to whom the road from Waycross, Ga., to Jacksonville has always been a stumbling block, will be glad to hear that the County Commissioners in Duval and Nassau counties, Florida, are now beginning to build a sand-clay road to the Georgia line, which will, when completed, it is claimed, be equal to any hard-surface road in the South. The new work will cover something over 60 miles, and will make the Dixie Highway in Florida soemthing more than a name. The approximate cost per mile as announced by William F. Cocke, State Highway Commissioner, will be around $800, with the use of convicts by the counties.

$145,000 Road-Building Contract.

Holmes County Supervisors, Lexington, Miss., have awarded contract for constructing 40 miles of gravel roads, for which bids were recently invited. Contract was awarded at $145,000 to the Inland Construction Co., Candler, Okla.

$240,000 Mississippi Drainage System.

Final surveys and estimates have been completed for the Indian Creek Drainage District, R. F. Sledge, president, Sledge, Miss., the cost to be $240,000. This system will drain 44,000 acres of delta land in Quitman, Tunica and Panola counties. The Morgan Engineering Co. of Memphis is the engineer. The district officials have accepted the engineer's report, and it is expected that arrangements will soon be made for awarding construction contracts. Twenty-year bonds will be issued, and the pro rata cost of the drainage will be from $5 to $5.50 per acre.

RAILROADS

[A complete record of all new railroad building in the South will be found in the Construction Department.]

JACKSONVILLE'S NEW RAILROAD TERMINAL.

$1,000,000 Building at Lee and Bay Streets Will Accommodate Five Roads.

Plans for the new million-dollar railroad terminal at Jacksonville, Fla., which will be used by all the lines entering there, show that the edifice will be handsome and imposing—an ornament to the city. The materials of which it will be constructed have not yet been announced in detail, but it is expected that Indiana limestone will be used for the exterior, a comprehensive view of which as it will appear being afforded by the accompanying illustration. The chief architectural feature is the row of 14 columns extending across the main entrances.

This portico is immediately in front of the main waiting-room, an apartment 150 feet long and 76 feet wide. It seats 375 persons. To the left of the picture is the waiting-room for colored people, also a commodious apartment 70x76 feet and seating 225 persons. Between the two waiting-rooms is the ticket office, with quarters for the ticket agent and a news stand on either side. Each room has its own lavatories, women's waiting-room, smoking-room, etc. At the right of the picture will be a commodious lunchroom and restaurant, with seats for 120 people. There is also a lunch counter adjoining the colored waiting-room.

Between the waiting-rooms, restaurant, etc., is a spacious concourse 410 feet long and 50 feet wide, on the opposite side of which are nine gateways leading to the 15 tracks. The baggage-rooms are also on the train side of the concourse. There are also to be nine other tracks immediately adjoining the station.

On either side of the portico and extending around the ends of the building will be a marquise of sufficient width to afford ample shelter from bad weather.

The terminal is to face on Lee street at the southwest corner of Bay street, which is on the right of the picture. Plans were prepared by Kenneth M. Murchison, architect, New York. The engineer in charge of the construction and representing the railroads is L. G. Wallis.

The several lines to be accommodated are the Atlantic Coast Line, the Florida East Coast Railway, the Georgia Southern & Florida Railway, the Seaboard Air Line and the Southern Railway.

NORFOLK & WESTERN'S BIG YEAR.

Over 35 Per Cent. Increase in Freight Revenues—Improvements to the Line.

An increase of more than 35½ per cent. in its revenues from freight traffic as compared with last year is shown by the annual report of the Norfolk & Western Railway covering the company's year, ended June 30, 1916. Its total operating revenues were $57,304,586.32, increase $14,317,542.55, of which increase $13,008,590 was from freight, the total revenues from freight being $49,559,139.91. The percentage of increase in all operating revenues was very nearly 33⅓ per cent. Total operating expenses were $32,181,345.95, increase $4,349,530.60, or about 15½ per cent. Net revenue from railway operations was $25,123,240.37, increase $9,968,011.95, or very nearly 65¾ per cent. Railway operating income after taxes and uncollectible railway revenues $23,054,786.26, increase $9,779,323.85, or more than 73½ per cent.; gross income $25,181,363.99, increase $9,862,668.19, or over 64⅓ per cent.; net income $20,624,056.57, increase $10,214,153.71, or more than 98 per cent.; income balance transferred to profit and loss after dividends on adjustment preferred stock $19,704,386.57, increase $10,214,152.71, or more than 107½ per cent.

Double-tracking of the line is being continued, and when work now in progress, amounting to about 15 miles, is finished next spring the road will have two tracks all the way from Lambert's Point, Norfolk, Va., to Columbus, O., with the exception of only about 3⅓ miles of single track, about 1¾ miles of which will be at Columbus and the rest in two short tunnels on the Radford and Pocahontas divisions, respectively. This includes the low-grade lines around Petersburg and Lynchburg, Va., the Burkeville-Pamplin connecting line in Virginia and the Big Sandy line as second track. The single track at Columbus is practically double track, for a parallel track of another road there is used jointly by the two companies.

Many improvements were made to the road and structures during the year. These included the relaying of 66 miles of track with 100-pound rails and the doube-tracking of the 10-mile branch to Hopewell, Va. Automatic signals were installed at a number of places and there are now 119 miles of single track and 527 miles of double track thus protected. Several yards were enlarged, including that at Lambert's Point. There were 16 highway grade crossings eliminated.

New rolling stock received during the year included 30 freight locomotives, 1 passenger locomotive, 4 electric locomotives, 24 passenger train cars, 671 all-steel gondola cars, 50 all-steel air dump cars, 42 steel underframe cabin cars, a steam derrick, a locomotive crane and several other minor pieces of equipment.

NEW TERMINAL PROPOSED FOR ATLANTA.

$6,500,000 Plan to Accommodate All Lines Submitted by A. G. Candler and Others.

A broad plan for the reconstruction and consolidation of railroad terminals in Atlanta has been submitted to the Western & Atlantic Railway Commission by the city and the Atlanta Chamber of Commerce. It was prepared by Messrs. Barclay, Parsons and Klapp of New York, and was presented to the commission by Asa G. Candler, Mayor-elect; Victor H. Kruegshaber, president, and Walter G. Cooper, secretary, of the Chamber of Commerce. J. H. Johnston, engineer, is investigating the plan, and is expected to soon file his report with the commission.

The proposition is that the old union passenger station and the comparatively new passenger terminal station be abandoned and that a new central station be built to accommodate the railroads which now are entering them. This would be on the site now occupied by the roundhouse of the Western & Atlantic Railway near the new terminal station, and it would front on Spring street, which would be extended across the present railroad property. Facing the station would be a spacious plaza, and continuing from it along the present railroad right of way past Forsyth, Broad, Peachtree and Pryor streets to Central avenue would be a new street made by filling in the chasm now occupied by railroad tracks. Two tunnels would have to be built to let the Georgia Railroad into the proposed new station. The new station trackage would be back of and through the station parallel with Spring street. It would cost about $6,500,000 to carry out the entire plan in its various details, and the city would foot the bill, finally reimbursing itself for the outlay by a system of rentals to be paid by the railroads.

Among the arguments in favor of the proposition is that the union station is too small and cannot be enlarged; that the terminal station is already filled to capacity and will soon be inadequate, and that the filling of the depression or shallow valley through which the railroads now cross the center of the city would remove a serious blemish upon its general appearance, besides accomplishing general results of great advantage to the entire population.

It will be necessary for the State of Georgia (through its ownership of the Western & Atlantic Railway), the city of Atlanta and the several railroad companies whose lines enter Atlanta to unite and co-operate if the plan is to be fulfilled. It is essential that the State become a party to it, and this is why the plan has been submitted to the commission in charge of the leasing of the Western & Atlantic Railway, now operated by the Nashville, Chattanooga & St. Louis Railway Co.

NEW UNION STATION TO BE BUILT AT JACKSONVILLE, FLA.

Construction Department

IN ORDER TO FOLLOW UP

Properly the Construction Department items, please bear in mind the following statements:

EXPLANATORY

The MANUFACTURERS RECORD seeks to verify the items reported in its Construction Department by full investigation. It is often impossible to do this before the item must be printed or else lose its value as news, and in some items it is found advisable to make statements as "reported" or "rumored," and not as positive information. If our readers will note these points they will see the necessity of the discrimination. We are always glad to have our attention called to errors that may occur.

HOW TO ADDRESS

The name of one or more incorporators of a newly incorporated enterprise should always be written on letter addressed to the official headquarters or to the town of the parties sought, as may be shown in the item. Sometimes a communication merely addressed in the corporate or official name of a newly established company or enterprise cannot be delivered by the postmaster. By following these general directions the post-office will generally be enabled to deliver your mail promptly, although it is inevitable that some failure by the postal authorities to deliver mail to new concerns will occur, as our reports are often published before new companies are known and before they have any established office for the receipt of mail.

WRITE PERSONAL LETTERS

In communicating with individuals and firms reported in these columns a letter written specifically about the matter reported will receive better and quicker attention than a circular. In most instances a return postal card or addressed and stamped envelope should be enclosed with letter.

In correspondence relating to information published in this department, it will be of advantage to all concerned if the Manufacturers Record is mentioned.

DAILY BULLETIN

The Daily Bulletin of the Manufacturers Record is published every business day in order to give the earliest possible news about new industrial, commercial, building, railroad and financial enterprises organized in the South and Southwest. It is invaluable to manufacturers, contractors, engineers and all others who want to get in touch at the earliest moment with new undertakings, or the enlargement of established enterprises. The subscription price is $25 per year.

All advertising contracts in the Manufacturers Record for three months or longer include a subscription to the Daily Bulletin for the contract period, as well as a subscription to the Manufacturers Record.

BRIDGES, CULVERTS, VIADUCTS

Ala., Mobile.—Mobile County Commrs. let contract Vincennes Bridge Co., Vincennes, Ind., at $3468 to install steel span on bridge across Dog River on Moffatt Rd. (Lately invited bids.)

Ala., Hedin.—Cleburne County Commrs. let contract Dodson & Oliver, Montgomery, Ala., at $4444 to construct steel bridge. (Lately invited bids.)

Ark., St. Francis.—Clay County Commrs. let contract to Vincennes Bridge Co., Vincennes, Ind., to construct $3495 bridge across St. Francis River and for bridge at Browns Ferry.

Fla., Pensacola.—Escambia Santa Rosa Bridge Co., capital $1000, incptd.; Peter Tomasello, Prest.; Jas. B. Perkins and Chas. Simpson, V.Ps.; W. M. Herrider, Secy.; E. R. Malone, Treas.; construct bridge across Escambia River at Ferry Pass; steel; reinforced foundations and dirt fill; total length, 2½ mi. (Noted in Aug. to have completed temporary organization, etc.)

Md., Baltimore.—State Roads Com., Frank H. Zouck, Chrmn., 601 Garrett Bldg., will construct 90-ft. reinforced concrete arch over Western Run along York Rd., No. B-21-Br.; bids until Sept. 26. (See Road and Street Work.)

Md., Thurmont.—Frederick County Commissioners, Frederick and Western Maryland Ry., H. R. Pratt, Ch. Engr., Baltimore, Md., plan to construct bridge between Thurmont and Sabillasville.

N. C., Lincolnton.—Lincoln County Commissioners, Lincolnton, and Mecklenburg County Commrs., Charlotte, contemplate constructing bridge across Catawba River at Beattie's Ford to replace structure destroyed by flood.

N. C., Worth.—Gaston County Commrs., O. B. Carpenter, Clk., will erect 2 steel bridges across South Fork River; one at Worth (or Harden); other at Vestal Ford, near Dallas; will let contract Oct. 5; noted in Aug. (under N. C., Gastonia) to rebuild flood-destroyed structures. (See Machinery Wanted—Bridges.)

S. C., Gaffney.—Cherokee County Commrs. let contracts Southern Bridge Co., Birmingham, Ala., to construct five bridges, and Converse Bridge & Steel Co. of Chattanooga, Tenn., to construct three bridges; total estimated cost, $65,000. (Noted in Aug. to rebuild and repair bridges damaged by flood.)

Tenn., Del Rio.—Cocke County Commrs., Newport, Tenn., voted $6500 appropriation to rebuild bridge at Del Rio.

Tex., Fredericksburg.—Gillespie County Commrs. will construct overflow concrete bridge across Pedarnales Crossing, 5 mi. from Fredericksburg.

W. Va., Charleston.—Kanawha County will construct highway bridge across Campbell's Creek under bridge of Kanawha & Michigan R. R. on north side of Kanawha River near Dana; bids until Oct. 7; F. G. Burdett, County Road Engr.; M. P. Malcolm, Prest. County Court. (See Machinery Wanted—Bridge Construction.)

W. Va., Franklin.—Pendleton County Commissioners will construct two bridges; bids until Sept. 25. (See Machinery Wanted—Bridges.)

Va., Sussex.—Sussex County will construct steel bridge 37 ft. long over Spring Swamp; bids at County Clerk's office until Sept. 21; G. P. Coleman, State Highway Commr., Richmond, Va. (See Machinery Wanted—Bridge Construction.)

CANNING AND PACKING PLANTS

Va., Cape Charles.—Pocomoke Oyster Co., capital $50,000, incptd.; Jas. C. Tawes, Prest.; Isaac T. Tawes, Secy.-Treas., both of Crisfield, Md.

Va., Petersburg.—Kings Creek Oyster Corporation, capital $25,000 chartered; J. Gordon Bohannon, Prest.; Oliver A. Pollard, Secy.-Treas.

COAL MINES AND COKE OVENS

Md., Baltimore.—Big Ben Coal Co., capital $200,000, incptd. by Henry Zoller, Jr. (217-219 St. Paul St.), Eugene C. Zoller, Edw. J. Star and others.

W. Va., Herndon.—Flat Top Pocahontas Coal Co., capital $50,000, incptd. by Jos. Keys, John D. White, W. A. Finney and others.

COTTON COMPRESSES AND GINS

Ark., Texarkana.—Citizens' Gin Co., capital $10,000, incptd. by A. M. McDaniel, H. Clark, F. E. Wilson and others.

Ark., Texarkana.—Farmers' Gin Co., capital $10,000, incptd. by J. W. Smith, H. F. Borcherding, C. H. Shroeder and others.

N. C., Moncure.—Moncure Mill & Gin Co., capital $25,000, incptd. by J. L. Womble, C. D. Orrel and C. B. Crutchfield.

COTTONSEED-OIL MILLS

Ala., Florence.—Florence Oil Co., capital $10,000, incptd. by J. O. Finney, W. C. Ashcraft and H. A. Bradshaw.

Ark., Pine Bluff.—Planters' Cotton Oil Co., capital $125,000, incptd. by Leo M. Andrews, Prest.; D. B. Niven, V.-P.; T. H. Gregory, Secy.-Treas.; purchased plant.

DRAINAGE SYSTEMS

Ark., Walnut Ridge.—Commrs. Lower Running Water Drainage Dist. (F. F. Sloan, Alicia, Ark., and others) let contract Peter Feldheiser to construct drainage canal; length, 8½ mi.; 25 ft. wide at bottom; average depth, 6 ft.; drain 15,000 acres; issued $25,000 bonds. (Noted in Aug. as inviting bids.)

Ga., Carnesville.—Commrs. Broad River Drainage Dist. let contract Long & Cooper at $95,000 to drain, ditch and dredge Broad River; district is 17 mi. long and will reclaim 3000 acres.

ELECTRIC PLANTS

Ark., Cotter.—M. A. Snyder, Tulsa, Okla and C. M. Martin, Muskogee, Okla., contemplate erection of electric-light plant.

Fla., Havana.—Board Public Works, O. M. Tillis, Chrmn., asks bids until Oct. 23 to construct water-works and electric-light plant; will issue $20,000 bonds noted voted in May. (See Machinery Wanted—Water-works and Electric-light Plant.)

Fla., Quitman.—City contemplates constructing electric-light system. Address The Mayor.

Fla., Plant City.—Company organized with John Gribbel, Prest.; D. J. Collins, V.-P.; J. D. Shadduck, Engr.; Roscoe Nettles, Secy., Treas. and Mgr.; acquired Plant City Ice & Power Co.'s properties; plans various improvements and enlargements, including new building, additional lighting facilities and extensions, enlargement of cold-storage features and increasing capacity of ice plant; later may consider erection of meat-ties. (Roscoe Nettles lately noted to have packing plant and larger cold-storage facili-secured franchise to build electric-light and gas plants.)

Ga., Damascus.—City votes Sept. 15 on $10,000 bonds to construct electric-light plant and water-works; J. D. Haddock, Mayor.

Ky., Franklin.—S. Walton Forgy of Elkton, Ky. (representing capitalists), applied for electric-light franchise; acquired Franklin Electric & Ice Co.'s plant for $62,000 and is reported to expend $13,000 for improvements.

Mo., Chillicothe.—City has plans by E. E. Harper, 2404 E. 30th St., Kansas City, Mo., for electric-light plant and water-works.

Mo., Excelsior Springs.—Excelsior Springs Water, Gas & Electric Co. will install 575-kilowatt generator direct connected to Corliss engine; has ordered equipment.

Mo., Knobnoster.—Knobnoster Electric Co. chartered with $20,000 capital by R. W. Morrison, W. S. McCall and Harry C. Loehr.

Mo., Rockport.—Chas. L. Hamer and O. W. Clifton applied for 20-year franchise to supply electricity; propose, if granted franchise, to purchase municipal electric-light plant.

Okla., Hennessey.—Hennessey Electric Light, Power & Ice Co. will construct electric-light plant.

S. C., Spartanburg.—Isolated Light & Power Co, capital $10,000, incptd. by W. D. Burnett and Geo. E. Ladshaw.

Tex., Denton.—City adopted plans for extending electric-light system. Address The Mayor.

Tex., San Benito.—San Benito Land & Water Co. is reported as contemplating installation of third 50 H. P. unit.

Tex., Vernon.—City plans improvements to electric-light plant, to include installation of 25 H. P. internal-combustion engine, double-suction centrifugal pump with capacity of 150 gals. per min., and generator of sufficient capacity to maintain 200 lamps and 100 candle-power. Address The Mayor.

FERTILIZER FACTORIES

Ga., Americus.—Tennessee Chemical Co. will double capacity of plant.

Md., Annapolis.—Special Committee, John M. Dennis, Chrmn., decided to locate one of two State limekilns in Southern Maryland at Pope's Creek, Charles County; install movable grinding machine. (Legislature noted in April to have appropriated $12,000 to build agricultural lime plant.)

FLOUR, FEED AND MEAL MILLS

N. C., Moncure.—Moncure Mill & Gin Co., capital $25,000, incptd. by J. L. Womble, C. D. Orrell and C. B. Crutchfield.

S. C., Anderson.—Burriss Milling Co. will install flour mill.

W. Va., Belington.—Belington Feed & Supply Co., capital $5000, incptd. by G. H. Proffitt, W. B. Baker, C. R. Keller and others.

FOUNDRY AND MACHINE PLANTS

Ga., Atlanta—Mill Supplies.—Seeger-Walraven Co., capital $15,000, incptd. by F. A. Seeger, J. R. Walraven and J. C. Walraven.

Ga., Atlanta—Cutting and Welding Equipment.—Bird-Wilcox Co., 24 Harwell pl., will build addition to cost $10,000; manufacture oxy-acetylene welding and cutting apparatus; branch plants at Savannah and Chattanooga.

Okla., Oklahoma City—Oil Cans, Iron Drums, etc.—V. M. Lord Mfg. Co. chartered, $50,000 capital; V. M. Lord, Prest.; O. H. Smith, V.-P.; E. B. Lord, Secy.; will manufacture oil cans, iron drums, etc.

N. C., Dunn—Blacksmith Shop, etc.—J. W. Thornton, lately noted to build blacksmith shop and garage, will erect 70x110-ft. 2-story ordinary brick building. (See Machinery Wanted—Cement, Lime, etc.)

W. Va., Huntington—Boilers.—Huntington Boiler Works, capital $5000, incptd. by B. F. France (Prest.), J. A. Diddle, E. B. Diddle and others.

GAS AND OIL ENTERPRISES

Ky., Frankfort.—Taylor-South-Hay Oil Co., capital $150,000, incptd. by E. H. Taylor, Jr., John G. South and C. W. Hay.

Okla., Blanchard.—Signal Hill Oil & Gas Co., capital $50,000, incptd. by C. N. Russell, F. J. Stafford, T. J. Lewis and J. M. Gordon.

Okla., Muskogee.—Cream Ridge Oil Co., capital $1100, incptd. by F. E. Coss, P. J. Carey and W. C Franklin.

Okla., Muskogee.—Harriman Oil & Gas Co. chartered with $25,000 capital by C. E. Harris and others.

Tex., Comanche.—Leon Valley Oil & Gas Co., capital $40,000, incptd. by G. A. Cunningham, Mrs. O. A. Nelly and H. D. Stewart.

Tex., Houston.—Selden Oil Co., capital $10,000, incptd. by F. S. Glover, E. A. Chritton and H. H. Everest.

Tex., Texas City.—Galveston County Oil Co., capital $20,000, incptd. by A. S. Tennille, A. B. Phillips and E. B. Gray.

Tex., Wichita Falls.—Texhoma Oil & Gas Co. chartered with $192,000 capital by A. W. Walker, W. B. Hamilton and H. M. Russell.

HYDRO-ELECTRIC PLANTS

Okla., Oklahoma City.—Blue River Power Co., capital $15,000, incptd. by W. M. Lucas, W. H. Bingham and D. C. Teter, all of Tishomingo, Okla.

ICE AND COLD-STORAGE PLANTS

Fla., Plant City.—Company organized with John Gribbel, Prest.; acquired Plant City Ice & Power Co.'s properties and plans various improvements. (See Electric Plants.)

Miss., Jackson.—Prison Trustees will install cold-storage plant at Parchman Farm.

S. C., Charleston.—Crystal Ice Co., capital $10,000, incptd. by G. F. Doscher and H. W. Bischoff.

Tenn., Chattanooga.—Cudahy Packing Co., Chicago, Ill., will build cold-storage plant to cost $15,000 to $20,000.

Tenn., Maryville.—Maryville Ice & Packing Co. is reported as contemplating increasing daily capacity of ice plant from 5 to 20 tons.

LAND DEVELOPMENTS

Okla., Ardmore.—Purity Pecan Plantation, capital $25,000, incptd. with W. F. Warren, Prest.; E. S. Stahl, V.-P.; R. A. Fox, Secy.-Treas.; erecting 3-story building.

Okla., Tishomingo.—City voted $12,000 bonds for park. Address The Mayor.

Tenn., Copperhill.—Greenwood Cemetery & Undertaking Co., capital $5000, incptd.

Va., Blackstone.—Broad-Acre Farm, capital $15,000, incptd.; J. W. Lawson, Prest., Blackstone, Va.; W. G. Epes, Secy., Vane, Va.

LUMBER MANUFACTURING

Ark., Bentonville.—Benton County Lumber Co. increased capital from $15,000 to $35,000.

Ky., Whitesburg.—Douglas-Walker Lumber Co., Pound, Va., is reported to have purchased several boundaries of timber lands along Kentucky-Virginia line; understood to build additional mill.

Ga., Augusta. — J. M. Card Lumber Co., Chattanooga, Tenn., contemplates building sawmill.

Miss., New Hebron.—Silver Lumber Co. organized; C. C. Eure, Prest.; A. E. Harbison, V.-P.; R. W. Dunn, Mgr.; has plant. (Lately noted, under Hattiesburg, as incptd. with $10,000 capital.)

Tex., Elmina.—Walker County Lumber Co. will build mill; has let contract for circular and gang equipment for daily capacity of 100,000 ft.

Va., Richmond.—Richmond Lumber Co., 4th St., between Decatur and Stockton Sts., let contract to H. L. Barker, 704 Lewis St., Richmond, to erect 75x220 ft. building; cost $7500; fireproof power plant; balance, mill construction; plans by D. Wiley Anderson, Richmond; Hackley Morrison, Richmond, Constr. Engr.; machinery practically purchased: planing mill; A. B. Dickinson, Prest.; W. C. Maddox, Secy.; A. G. Frostick, Mgr. (Under Machinery Wanted—lately noted as needing smokestack.)

Va., Warsaw.—Henrico Lumber Co. increased capital from $100,000 to $300,000.

METAL-WORKING PLANTS

Md., Baltimore—Copper Smelting. — Baltimore Copper Smelting & Rolling Co., 4th Ave. and 5th St., is understood to have decided upon further additions to plant; expend $500,000 for buildings and machinery to increase monthly capacity by $5000 tons, increasing present output to 25,000 tons.

MINING

Ala., Clanton—Graphite.—Dixie Graphite Developing & Mining Co., capital $5000, incorporated by Robt. E. Gill and W. R. Darring of Birmingham, T. M. Hilton and W. M. Glass of Jemison, Ala.

Ala., Lineville—Graphite.—Lineville Graphite Co., capital $30,000, incptd. by Wyatt J. Green, C. E. Smith, J. C. Kilgore and others.

Ark., Batesville.—Commercial Mining Co. increased capital from $5000 to $10,000.

Ark., Marshall.—Alverta Mining Co., capital $50,000, incptd. with W. F. Reeves, prest.

Ark., Zinc—Zinc.—Era Mining Co., capital $12,000, incptd. with J. N. Kirby, Prest.

Tex., Beaumont—Rock.—Texas Rock Co. increased capital from $10,000 to $20,000.

Va., Goshen — Mica Schist.—Appalachian Iron, Steel & Mfg. Co., general office in Du Pont Bldg., Wilmington, Del., contemplates developing micaceous deposit.

Va., Richmond — Gold. — Confidence Gold Mines Corp., incptd.; W. A. Strata, Prest., Richmond; Warren B. Hunting, Secy-Treas., Bronxville, N. Y.

MISCELLANEOUS CONSTRUCTION

Ala., Mobile—Coal Docks.—Louisville & Nashville R. R., W. H. Courtenay, Ch. Engr., Louisville, Ky., will rehabilitate coal docks; blueprints prepared; electrically operated hoists; cost, including machinery, $78,600.

Ark., Judsonia—Levee.—O. M. Erganbright, Prest. First National Bank, has contract to construct $50,000 levee 5 mi. southeast of Judsonia.

Fla., Sarasota — Recreation Pier. — City voted $18,000 bonds to construct recreation pier in Sarasota Bay; reinforced concrete; extend 700 ft. into bay; Robt. C. Bruce, Commr. of Public Works. (Noted in June.)

Miss., Clarksdale.—Yazoo-Mississippi Delta Levee Board let contract Banister & Co. of Marks, Miss., to construct 3,000,000 yds. of levee.

S. C., Charleston—Electrical.—John C. Slattery Electrical Co., capital $5000, incptd by John C. Slattery and Frank F. Cosgrove.

Tenn., Memphis—Levee.—Mississippi River Com., U. S. Engr.'s office, Custom-house, let following contracts for levee construction in First and Second Mississippi River Dists.: R. L. Leonard, 225,000 cu. yds. enlargement in Upper St. Francis Levee Dist.; rejected bids and re-advertise for proposals or. 300,000 cu. yds.; Roach, Stansell, Lowrance Bros. & Co., 380,000 cu. yds. loop and banquette work in Reelfoot Levee Dist.; Rodgers Bros., 400,000 cu. yds. loop and banquette work, and R. L. Leonard, two items of 200,000 cu. yds. and 300,000 cu. yds., respectively, enlargement work in Lower St. Francis Levee Dist.; rejected bids on 470,000 cu. yds. construction in this district and will re-advertise for proposals; also rejected bids for 400,000 cu. yds. levee in White River Levee Dist. (Lately noted inviting bids on 2,655,000 cu. yds. earthwork.)

Tenn., Newbern — Levee.—Dyer County Commrs., Dyersburg, Tenn., appointed W. F. Milam and others as committee to construct levee at Wyatt Creek near Newbern.

Tex., Beaumont—Wharf.—City voted $330,000 bonds, of which $230,000 will be expended to complete municipal wharf under construction and to build additional quay wall; latter to be 1000 ft. long, 30 ft. wide, and cost $170,000; remaining $100,000 to complete water-works improvements and extend water mains to various parts of city; C. L. Scherer, City Engr. (Noted in Aug.)

Tex., Corsicanna—Garbage Disposal Plant. City let contract to Superior Furnace Construction Co. for garbage destructor plant.

Tex., Farmersville.—Collin County Levee Improvement Dist. No. 1 (T. E. Ball and others) is having preliminary plans prepared by State Reclamation Dept., Arthur A. Stiles, State Reclamation Engr.; reclaim 4000 acres in valley of Pilot Grove Creek; $42,000 bonds voted.

Tex., Houston.—City appropriated $19,000 to construct 3 apron conveyors at turning basin No. 4; let contract to Edward Hanak Contracting Co.

Va., Norfolk—Railway Pier.—Chesapeake & Ohio Ry. Co., will build pier in connection with warehouse construction; F. I. Cabell, Ch. Engr., Richmond, Va., advises Manufacturers Record: Not in position to give information in regard to proposed work.

MISCELLANEOUS ENTERPRISES

Ala., Birmingham—Fishery.—Independent Fish Co., capital $10,000, incptd.; L. Goodman, Prest.; S. Balsam, V.-P. and Treas.; A. Balsam, Secy.

Ky., Louisville—Publishing.—Market Growers' Journal Co., capital $12,500, incptd. by Wade Sheltman, Jas. C. Stone, Jas. C. Willson and others.

Md., Baltimore—Steamship Line.—Wirginia-Carolina Navigation Co. incptd. to build and operate two steel shallow-water steamers between North Carolina sounds and Baltimore; temporary office with M. H. Tracy & Co., Foreign and Coastwise Transportation, 17 State St., New York; advises will soon furnish further information.

N. C., Wilmington — Fishery. — Fisheries Products Co., capital $125,000, incptd. by Thos. W. Hayes of Newport, R. I.; Thos. W. Davis and Louis J. Poisson of Wilmington; reported to have leased plant of Carolina Fish & Oil Co. on Cape Fear River with daily capacity for handling 5000 bbls. fish.

Tex., Galveston—Asphalt Refinery.—Barber Asphalt Paving Co., Philadelphia, Pa., may establish $300,000 plant to refine asphalt; T. H. Barton representative, Hotel Galvez, Galveston, now investigating relative to final decision.

Tex., San Antonio — Moving Pictures. — Gotham Film Corp., Marshall W. Taggart, Prest., New York, is reported to establish moving picture film plant: erect stage 300x150 ft.

Tex., Waco—Police Signal System.—City will install police signal system: cost $3708.60. Address The Mayor.

MISCELLANEOUS FACTORIES

Ala., Montgomery — Cereals. — Southern Cereal Co., capital $10,000, nicptd. by Otis F. Tutt, Walter R. Brassell and Paul Roeder.

Ala., Montgomery—Cloth Hats, etc.—Lipson-Friedman Mfg. Co. organized to manufacture children's cloth hats, caps, etc.

Ala., Montgomery—Syrup.—Southern Syrup Co., (partnership), Ralph D. Quisenberry, Prest. and Frank McPherson, V.-P., will open bids on erection of 100x180 ft. mill-construction building; plans by Okel & Cooper, Montgomery; install refining machinery. (Lately noted purchasing factory and to equip for syrup refinery.)

Fla., Dover—Bottling.—Evars' Gardens is interested in proposed installation of bottling machinery. (See Machinery Wanted—Bottling Machinery.)

Fla., Jacksonville—Fruit Products.—Florida Fruit Preserving Co., capital $25,000, organized to establish factory for marmalades and jellies from citrus fruits; E. Hening Smith, Prest.-Gen. Mgr., Jacksonville; C. L. Farnsworth, Gen. Supt., Tavares.

Fla., Otter Creek—Fiber Brushes.—G. W. Hires will establish plant to manufacture fiber brushes; has building; ready to purchase machinery. (Under Machinery Wanted data and prices on equipment for this plant lately noted desired by Franklin E. Davis, Export Terminals, Talleyrand Ave. and Jessie St., Jacksonville, Fla.)

Ky., Louisville—Monuments.—Woodson & Kratch Monument Co., capital $10,000, incptd. by Isaac T. Woodson, Fred A. Kratch and C. E. Woodson.

Ky., Louisville—Cereals.—Beechnut Cereal Co. incptd. by O. E. Katzman, Sam McDonald, Lawrence K. Tully and Raynor Hubbell.

Mo., St. Louis — Razor Strops. — Missouri Razor Strop Co., capital $4000, incptd. by Rawin Ficher, Peretz A. Goldstein, Max Svetsinsky and Sam A. Goldstein.

Mo., St. Louis—Tires.—Superior Tire & Supply Co., 4208 Virginia Ave., organized; Emil Handschug, Prest.; Earl Handschug, V.-P. and Mgr.; Victor H. Handschug, Secy.; will install pumps, vulcanizers, buffing stands, motors and double treading machines, cost $800; product, repaired tires and double-treaded tires. (Lately noted chartered.)

N. C., Gastonia—Overalls.—J. F. Manning of Detroit, Mich., is reported as planning to establish overall factory.

Okla., Oklahoma City—Oil Cans, etc.—V. M. Lord Mfg. Co., lately noted chartered, will manufacture oil cans, iron drums, etc. (See Foundry and Machine Plants.)

S. C., Estill—Bottling, etc.—Estill Mfg. Co., capital $25,000, incptd. by Frank Causey, Jr., R. T. Causey, C. L. Peeples and others.

Tenn., Springfield — Tobacco. — McMurry Loose Leaf Tobacco Co., capital $15,000, incptd. by A. S. McMurry, P. G. McMurry, Wm. McMurry and A. L. Dorey.

Tex., Austin—Paper.—A. C. Goeth and others contemplate establishing mill to manufacture paper from cottonwood; plan to utilize electric power.

Tex., Houston—Mattresses.—M. C. Champion Mattress Mfg. Co., capital $5000, incptd. by J. A. Daley, M. C. Champion and Chas. Murphy.

Va., Alexandria — Pasteurizer. — American Pasteurizer Co. chartered with $100,000 capital; Godfrey M. S. Tait, Prest., Washington, D. C.

Va., Petersburg—Bathing Outfits.—Kwick-Bath Mfg. Co., organized; W. T. Clute, Prest.; Geo. B. Baker, Secy.-Treas.; plans to manufacture bathing outfits for homes, etc.; portable equipments including folding tub with 20 gal. tank, etc. (Lately noted incptd. with $50,000 capital.)

W. Va., Fairmont.—Ludwic Thiele of Columbus, O., is preparing plans for factory to be erected on Tygart Valley River; cost $75,000.

MOTOR CARS, GARAGES, TIRES, ETC.

Ala., Gadsden—Garage.—Hollingsworth Estate (E. T. Hollingsworth and others) has plans by A. D. Simpson for garage; 60x125 ft.; brick; will be occupied by Smith & DuBose.

Ark., Walnut Springs—Garage.—Henderson & Wood let contract T. J. Young to erect garage; 1 story; brick; 60x100 ft. with basement 30x50 ft.

Ga., Macon—Garage.—Water Commrs. will erect brick garage.

Ga., Swainsboro—Garage, etc.—W. O. Sanders, Box 234, had plans by and let contract to J. C. & C. H. Sutton, Swainsboro, to erect 2-story building, to contain garage, show and stock rooms, office, etc.; cost without equipment, $4000; brick construction, tin roof, wood floors; electric wiring. (See Machinery Wanted—Hardware, etc.)

Ky., Louisville—Garage.—Geo. Hoertz, Sr., will erect brick garage to cost $3000.

Okla., Muskogee—Automobiles.—Anderson Motor Sales Co., capital $5000, incptd. by C. C. Anderson, W. W. Anderson and C. L. Anderson.

Tenn., Bristol.—A. J. Sheldon will rebuild garage reported burned at loss of $12,000.

Va., Kinsale—Automobiles.—Kinsale Motor Corp., capital $15,000, chartered; John A. Palmer, Jr., Prest., Fleeton, Va.; R. B. Moore, Secy.-Treas., Reedville, Va.

Va., Warsaw—Automobiles.—Warsaw Motor Corp., capital $15,000, chartered; John A. Palmer, Jr., Prest., Fleeton, Va.; R. M. Moore, Secy.-Treas, Reedville, Va.

RAILWAY SHOPS, TERMINALS, ROUNDHOUSES, ETC.

Va., Portsmouth.—Seaboard Air Line Ry., W. D. Faucette, Ch. Engr., Norfolk, Va., decided to rebuild burned coach shops in Norfolk.

ROAD AND STREET WORK

Ala., Gadsden.City will construct 2200 sq. yds. sidewalks and 175 ft. curbs and gutters; bids at City Clerk's office, City Hall, until Sept. 18; Ernest Smith, City Engr.; lately noted to issue bonds. (See Machinery Wanted—Paving, etc.)

Ala., Rockford.—Coosa County will construct 4 mi. Clisby Rd.; 5 mi. Turnpike Rd.; 3 mi. Smith's Ferry Rd.; 8 mi. from Goodwater to Talladega county line by way of Mount Olive; 3 mi. from Soccopotoy to Tallapoosa county line by way of Kellyton; bids until Sept. 19; Lofton Thomas, Judge of Probate. (See Machinery Wanted—Road Construction.)

Ala., Vernon.—Lamar County Public Highway Commrs. will invite bids to construct 15 mi. road to complete route of proposed Jackson Highway through county.

Ark., Clarksville.—Johnson County Commissioners contemplate construction of road from Coal Hill through Clarksville to Sebastian county line, 32 mi.; macadam; estimated cost $130,000.

Ark., Little Rock.—Improvement Dist. will improve 50 blocks; asphalt macadam; street construction with concrete curb and sidewalks; date of opening bids not set; $52,000 available; Engrs., Ford & McCrae, Little Rock. (Lately noted under Pulaski Heights, P. O. Little Rock.)

Ark., Osceola. — Mississippi County Commissioners contemplate constructing road from Blytheville north toward Osceola, 27 mi.; concrete; estimated cost $225,000.

Fla., Macclenny.—Baker County Commrs. will order election to vote on $60,000 bonds to construct roads.

Fla., Ormond.—City voted bonds to construct boulevard. Address The Mayor.

Ky., Covington.—Kenton County Commrs. let contract Zach Hedger at $22,000 to improve 4 mi. of road.

Ky., Henderson.—Henderson County Commissioners let contract Ed Manion of Henderson to rebuild 3¼ mi. Smith Mills-Morganfield Rd.; cost $22,000.

Ky., Henderson.—Henderson County, Otis A. Berton, Clk., let contract to E. Manion, Henderson, to construct 3¼ mi. macadam road; $24,000 available; S. H. Kimmell, Road Engr., Henderson. (Bids lately noted.)

Ky., Lexington.—City will construct concrete sidewalks, 4 ft. wide, on both sides of Columbia Ave. from Woodland to Locust Ave.; bids opened Sept. 11; W. H. McCorkle, Commr. Dept. of Public Works. (See Machinery Wanted—Paving.)

Md., Baltimore.—State Roads Com., Frank H. Zouck, Chrmn., 601 Garrett Bldg., will construct 5 mi. of road from end of Showell Rd. north toward Selbyville, concrete or macadam, oil bound, Contract No. Wo-13, Worcester County; also 90-ft. reinforced concrete arch over Western Run along York Rd., Contract No. B-21-Br.; bids until Sept. 26. (See Machinery Wanted—Road and Bridge Construction.)

Md., Baltimore.—City will grade and pave with cement-concrete various alleys; bids until Sept. 20; R. M. Cooksey, Highways Engr. (See Machinery Wanted—Paving.)

Md., Baltimore.—Board of Awards, John Hubert, Prest., asks bids until Sept. 27 on sheet asphalt, vitrified block and wood block paving, Contract No. 140, Lexington and Etting Sts.; also sheet asphalt, vitrified block paving and granite block repaving, Contract No. 141, Gay St.; R. Keith Compton, Chrmn. and Consit Engr., Paving Com., 214 E. Lexington St. (See Machinery Wanted—Paving.)

Miss., Coffeeville.—Yalobusha County Supervisors voted $100,000 bonds to improve roads.

Miss., Grenada.—Grenada County will construct 50 mi. sand-clay roads; County Supervisors, M. E. Powell, Clerk, receive bids until Oct. 2; amount available for total road construction, $100,000; Snowden & Hauser, Civil Engrs., Jackson, Miss.; lately noted as having surveys made by Snowden & Hauser for 100 mi. of road, part of Jefferson Davis Highway. (See Machinery Wanted—Road Construction.)

Miss., Lexington.—Holmes County Supvrs., Dist. No. 1, let contract to Inland Construction Co., Candler, Okla., at $145,000, to construct 40 mi. gravel roads; contract includes labor and furnishing materials with exception of gravel for surfacing and pipes for culverts; Stein & Harbert, Engrs., Indianola, Miss. (Bids noted in Aug.)

Miss Meridian.—City let contract John E. Wright to construct concrete curbs and gutters on 5th and 8th Sts. and 18th and 24th Aves.; J. C. Watts, City Engr.

Mo., Hartville.—Wright County voted $40,000 bonds to construct roads. Address County Commrs.

Mo., Joplin.—City let contract D. C. Turnbull at $4394.16 to pave Joplin St. from 26th to 32d St. with macadam.

Mo., Kansas City.—City let contract E. D. Tyner Construction Co. to pave McGee St. from 15th to 20th St. with creosoted wood blocks.

Mo., Marble Hill.—Bolinger County Commissioners advise Manufacturers Record: Bond election called off; will not again be taken up before next spring. (Lately reported to call election on $100,000 bonds.)

Mo., St. Louis.—City will reconstruct Locust St. from Jefferson to Theresa Ave.; City, Room 315 New City Hall, receives bids until Sept. 22; information from office of Prest., Room 326 New City Hall. (See Machinery Wanted—Paving.)

N. C., Asheville.—City Commrs. authorized improvement of 28 streets.

N. C., High Point.—City ($50,000 bonds recently mentioned) will contract for 40,000 sq. yds. and alternate bids on 100,000 sq. yds. paving; sheet asphalt, bituminous concrete, brick and durax block considered; bids until Sept. 28; plans and specifications at office Arthur Lyon, City Engr., and of Anderson & Christie, Consit. Engrs., Charlotte, N. C. (See Machinery Wanted—Paving.)

N. C., Lenoir.—L. P. Henkel of Statesville, N. C., and others plan to construct road between Lenoir and Blowing Rock; 22 mi.; concrete; width, 9 ft. along straight of way and 12 ft. on curves; cost $150,000.

N. C., Morganton.—Bruce County, Quaker Meadow Township, votes Oct. 14 on $20,000 bonds to construct roads; J. M. Brunkley, Chrmn. County Commrs.

N. C., Morganton.—Burke County, Silver Township, votes Sept. 30 on bonds to construct roads. Address County Commrs.

N. C., Winston-Salem. — Forsyth County Highway Commission, Jas. A. Gray, Jr., will let contract to construct road from Salisbury Rd. to south end of Broad St., about 1 mi.

Okla., Blackwell.—City plans vertical fiber vitrified brick paving on concrete base, cost about $40,000; bids until Sept. 11; Street Improvement Districts Nos. 2 and 3; Benham Engineering Co., Oklahoma City, Engr.

Okla., Bartlesville. — Washington County will vote on bonds to construct roads. Address County Commrs.

S. C., Chester.—City, Z. V. Davidson Mayor, contemplates expenditure of $115,000 on street paving; character, etc. not yet decided; Jas. Hamilton, City Engr.; H. S. Jaudon, Savannah, Ga., Consult. Engr. (Lately noted to vote on bonds.)

Okla., Clinton.—City will pave about 15 blocks in business district; cost about $80,000; retained Benham Engineering Co., Oklahoma City, to draw plans and specifications and supervise construction.

Okla., Sand Springs.—City will construct asphaltic concrete pavement, cost $110,000; will ask bids; Benham Engineering Co., Oklahoma City, Engr. (Noted in June.)

S. C., Greenville.—City votes Sept. 26 on $65,000 bonds to pave streets. Address The Mayor.

Tenn., Chapel Hill.—Turnpike Co. let contract R. A. Wilkes of Columbia, Tenn., to construct 6 mi. road from Chapel Hill to Unionville.

Tenn., Fayetteville.—Lincoln County Commissioners ordered vote Oct. 7 on $450,000 bonds to construct roads.

Tenn., Morristown.—City let contract Murray Construction Co., Knoxville, Tenn., to pave streets in Improvement Dists. Nos. 8 and 9, including portions of E. 3d, Henry, 2d and other streets; Chas. S. Stephens, Recorder. (Lately noted inviting bids.)

Tenn., Newport.—City, Geo. F. Smith, official in charge, has formed improvement district; upon sale of bonds will probably expend $15,000 for asphalt pavement; has $5000 available for macadam paving. (Lately noted to pave 2 mi. streets.)

Tex., Amarillo.—City Com. plans paving 50 additional streets. Address The Mayor.

Tex., El Paso.—City is considering street paving; to cost $130,000; City Engr. James Gladding has submitted estimates, including following: Myrtle St. from Ange to Alameda, $91,337; Dallas St. from Myrtle to Montana, $30,869; Chihuahua from Improvement Dist. No. 1 to Second, $8169. Address City Clerk.

Tex., Mount Pleasant.—City, J. F. Wilkerson, Mayor, will open bids Sept. 18 to construct lately-noted street paving, etc.; 8500 sq. yds. paving, 10 catch-basins, 2500 cu. yds. excavation, 2000 lin. ft. sewer; H. S. Wilder, Engr., Mt. Pleasant. (See Machinery Wanted—Paving.)

Tex., Palestine.—City will construct paving, Public Square, contemplates paving in residence section at cost of $25,000. Address City Clerk.

Tex., Redwater.—Redwater Precinct will construct roads; $25,000 bonds voted. Address The Mayor.

Tex., Sulphur Springs.—City is reported to have let contract to construct about 10 mi. streets. Address City Clerk.

Va., Covington.—Alleghany County Commissioners voted $100,000 bonds to construct roads in Covington Dist.

Va., Hopewell.—City, C. F. Camp, Mayor, is having specifications prepared for bids on street and sidewalk construction.

Va., Newport News.—City will probably soon vote on proposed $50,000 bonds for street and sewer improvements. Address The Mayor.

Va., Richmond.—City invites bids for granolithic paving on 14th St.; Chas. E. Bolling, City Engr.

W. Va., Broad Oaks, P. O. at Clarksburg.—Town contemplates voting on $18,000 bonds to pave streets. Address Town Clerk.

W. Va., Charleston. — Kanawha County, Loudon Dist., voted $90,000 bonds to construct roads; L. C. Massey, Clerk County Court. (Noted in Aug.)

W. Va., Charleston. — Kanawha County Court let contract Central Engineering Co., Charleston, W. Va., at $100,000 for construction Kanawha and James River turnpike, portion on Midland Trail between Charleston and St. Albans; 3½ to 5 mi.; asphalt concrete with 5-in. concrete base; 40,000 cu. yds. excavation, 45 to 65 sq. yds. asphaltic concrete, necessary sewers, culverts and bridges. (Lately invited bids.)

W. Va., Fayetteville.—Fayette County, Fayetteville Dist., issued $800,000 bonds for road construction; J. K. McGrath, Mount Hope, W. Va., Engr.; R. J. Stegall, Clk. County Court. (Bonds noted voted in June.)

W. Va., Fayetteville. — Fayette County, Sewell Mountain Dist. issued $175,000 bonds for road construction; T. F. Maloy, Engr., Landisburg, W. Va.; R. J. Stegall, Clk. County Court. (Bonds noted voted in June.)

W. Va., Fayetteville. — Fayette County, Falls Dist., issued $175,000 bonds for road construction; T. F. Maloy, Landisburg, W. Va., Engr.; R. J. Stegall, Clk. County Court. (Bonds noted voted in June.)

W. Va., Hinton.—Summer County Commrs. let contract S. C. Ballengee of Talcott, W. Va., to construct road from Talcott to Forest Hill Dist. line by way of Greenbrier Springs.

W. Va., Lewisburg.—Greenbrier County Court ordered election Oct. 7 on $103,000 bonds for road improvements. (Noted in Aug. as receiving bids until Aug. 31 for 18 mi. macadam road, etc.)

W. Va., Parkersburg.—City will construct 1516 sq. yds. vitrified brick paving on concrete base with cement filler and 313 sq. yds. one-course cement paving; concrete curbing; bids until Sept. 20; Frank Good, City Clerk. (See Machinery Wanted—Paving.)

W. Va., Wayne.—Wayne County Commrs. let contract Frank Duval of West Huntington, W. Va., at $22,560 to construct remaining mile of Piedmont Rd. between Ceredo and Huntington. (Call for bids lately noted.)

SEWER CONSTRUCTION.

Ala., Montgomery.—City votes Oct. 17 on $25,000 bonds to construct sanitary sewers. Address City Commrs.

Ark., Little Rock.—Improvement Dist. (Pulaski Heights) will construct sanitary sewers; $50,000 available; Engrs., Ford & McCrae, Little Rock. (Noted in July.)

Fla., Pensacola.—City let contract to Chas. A. Born, Pensacola, to construct 2200 ft. 20-in. terra-cotta drain at $2.10 per ft.; manholes, etc.; L. Earle Thornton, City Engr. (Bids noted in Aug.)

Ga., Lithonia.—City votes Oct. 12 on $35,000 bonds to construct sewer system and water-works. Address The Mayor.

Miss., Crystal Springs.—City will vote on bonds within 30 days for lately-noted sanitary sewer system construction; Xavier A. Kramer, Consit. Engr., Magnolia, Miss., is preparing preliminary plans.

Mo., Milan.—City is preparing plans for sewer system; cost $25,000; E. T. Archer & Co., Engrs., Kansas City, Mo.

Mo., Poplar Bluff.—St. Louis & San Francisco R. R., F. G. Jonah, Ch. Engr., St. Louis, Mo., is reported as contemplating construction of sewers; cost $20,000.

Okla., Commerce.—City contemplates bond election for sanitary sewer construction; Benham Engineering Co., Consit. Engr., Oklahoma City, has made estimate on system to cost $30,000.

Okla., Cordell.—City sewer districts being organized, amounts about $40,000; $25,000 bonds (noted voted in Aug.) to be issued; Benham Engineering Co., Oklahoma City, Consit. Engr.

Okla., Kusa.—City will vote on bonds to construct sewer system. Address The Mayor.

Okla., Norman.—City voted $7000 bonds to construct sewers. Address The Mayor.

Okla., Sand Springs.—City voted $30,000 bonds for storm sewer system, to be constructed in connection with paving; Benham Engineering Co., Oklahoma City, Consit. Engr.; noted in June. (See Road and Street Work.)

Okla., Tulsa.—City will construct sanitary sewer, including laterals, connections, etc., in Dist. No. 24; bids opened Sept. 11; H. H. Wyss, City Engr. (See Machinery Wanted—Sewer Construction.)

S. C., Greenville.—City votes Sept. 26 on $25,000 bonds to extend sewers. Address The Mayor.

Tex., Celina.—City, W. E. Seitz, Mayor, conteplates improvements to sewage disposal plant.

Tex., Garland.—City, G. W. Crossman, Mayor, engaged M. Griffin O'Neill & Son, Dallas, Tex., to make estimate of cost of water-works and sewer system.

Tex., College Station. — Agricultural & Mechanical College of Texas plans construction of sewer system and sewage-pumping unit; G. E. Byers, Supt. Buildings and Grounds.

Tex., Gainesville.—City is having plans prepared by N. Werenskiold, Dallas, Tex., for sewage treatment plant, capacity 200,000 gals. sewage daily.

Tex., Jacksonville.—City completed remodeling of sewage disposal plant and will let contract for improvements to another plant.

Tex., Lufkin.—City, H. Davis, Mayor, contemplates sewage improvements, cost $4000. (Noted in July.)

Tex., Mineola.—City votes Sept. 12 on $9000 bonds to extend sewer system. Address The Mayor.

Tex., Wills Point.—City let contract at $18,000 to Dalton & Campbell, Dallas, for sewer system and disposal plant; Imhoff tank, dosing chambers, coke filters, disinfecting apparatus; about 40,000 ft. 6, 8 and 10-in. pipe.

Tex., Wharton.—City is having plans prepared by John A. Morris, Wharton, for sewage treatment plant.

Va., Newport News.—City will probably soon vote on proposed $50,000 bonds for sewer construction and street improvements. Address The Mayor.

TELEPHONE SYSTEMS

Ark., Warren.—South Arkansas Telephone Co., capital $15,000, incptd. by H. Thame, D. A. Gates, W. J. Savage and W. J. Camp.

Tenn., Fosterville. — Fosterville Mutual Home Telephone Co., incptd. to operate telephone system from Bedford into Rutherford County.

Tex., Mount Calm.—Mount Calm Telephone Co., capital $15,000 incptd. by J. F. Dixon, W. J. Shilling and B. Hillyer.

TEXTILE MILLS

Ala., Mobile — Cotton Specialties.—Pope Mfg. Co., R. P. Pope, Prest., let contract to E. J. Raub & Co., Mobile, for construction 1-story brick building with 13,000 sq. ft. floor space; cost $10,000; Wetzel & March, Archts., Mobile; install machinery to manufacture cotton specialties. (Lately noted incptd. with $50,000 capital.)

Ky., Maysville—Woolen Goods.—January & Wood Co. was established in 1851; incptd. in 1888 with $200,000 capital; reincptd. in August, 1916; extensive improvements begun last year are nearing completion. (Lately noted incptd. with $200,000 capital.)

N. C., Brookford—Hosiery.—E. L. Shuford, Hickory, N. C., will organize $10,000 company to establish hosiery-knitting mill; has 3-story 50x40-ft. brick building; install 12 knitters, 7 loopers, 18 ribbers, etc.; daily capacity, 150 pairs hosiery; has purchased machinery. (E. L. Shuford, Hickory, lately noted to build hosiery mill.)

N. C., Charlotte—Cotton Cloth.—Highland Park Mfg. Co., Chas. W. Johnston, Prest., advises Manufacturers Record. Never any foundation for report; positively not to build any new mills at present. (Chas. W. Johnston and associates lately reported to build $1,000,000 mill.)

N. C., Charlotte—Absorbent Cotton, etc.—F. D. Spencer, 1814 Winthrop Ave., may establish absorbent cotton and gauze mill. (See Machinery Wanted—Cotton Machinery.)

N. C., Mooresville—Cotton Cloth.—Mooresville Cotton Mills let contract to W. H. Rose, Goldsboro, N. C., for construction 1-story 410x127 ft. spinning mill and 420x137 ft. weaving mill; will install 10,000 spindles, with accompanying twisters, looms, etc.; purchased this machinery. (Lately noted increasing capital from $400,000 to $1,000,000 for erection additional mill, etc.)

N. C., Shelby—Hosiery.—Olive Hosiery Mfg. Co., capital $100,000, incptd. by S. S. Royster, D. W. Royster and H. R. Royster.

WATER-WORKS

Fla., Havana.—Board Public Works, O. M. Tillis, Chrmn., asks bids until Oct. 23 to construct water-works and electric-light plant; will issue $20,000 bonds noted voted in May. (See Machinery Wanted—Water-works and Electric-light Plant.)

Fla., Quitman.—City contemplates constructing water-works. Address The Mayor.

Ga., Damascus.—City votes Sept. 15 on $10,000 bonds to construct water-works and electric-light plant; J. D. Haddock, Mayor.

Ga., Lithonia.—City votes Oct. 12 on $35,000 bonds to construct water-works and sewer system. Address The Mayor.

Ga., Macon.—Water Commrs. will acquire private water system in South Macon; install 7000 ft. of pipe.

Md., Brunswick.—City, Eugene Harrison, Mayor, will expend $75,000 on water-works improvements; daily capacity 400,000 gals.; no buildings; construction to include wood stave pipe to springs, cast-iron mains and concrete-lined earth reservoir of 3,000,000 gals. capacity; Engrs., Norton, Bird & Whitman, 1320 Munsey Bldg., Baltimore, Md. (Lately noted.)

Mo., Chillicothe.—City has plans by E. E. Harper, 2404 E. 30th St., Kansas City, Mo., for water-works and electric-light plant.

N. C., Hickory.—City let contract W. R. Hart to install 8000 ft. water main on 12th and 15th Sts. and 6th Ave.

Okla., Granite.—City retained Benham Engineering Co., Oklahoma City, to make investigations and prepare plans and specifications for water supply to cost about $25,000.

Okla., Hollister.—City contemplates voting on bonds to construct water-works. Address The Mayor.

Okla., Idabel.—City will improve and extend water-works; F. D. Taafe, Engr.; T. J. Bookout, City Clerk.

Okla., Norman.—City voted $3000 bonds to construct water-works. Address The Mayor.

Okla., Redrock.—City will construct water-works. Address The Mayor.

Okla., Wetumka.—City contemplates expending $40,000 to improve water system. Address The Mayor.

Tenn., Knoxville.—City Com. voted to call election for Oct. 21 to vote on $225,000 bonds for water-works improvements to include installation of pump of from 10,000,000 to 15,000,000 gals. daily capacity; J. R. McCallie, City Engr. (Noted in Aug.)

Tex., Abilene.—City Com. contemplates extending water system. Address The Mayor.

Tex., Beaumont. — City voted $100,000 to complete water-works improvements and extend water mains to various parts of ity; C. L. Scherer, City Engr.; noted in Aug. (See Miscellaneous Construction.)

Tex., Edinburg.—City Council appointed E. M. Card, Edinburg, engineer to design water purification plant.

Tex., Garland.—City, G. W. Crossman, Mayor, engaged M. Griffin O'Neill & Son, Dallas, Tex., to make estimate of cost of water-works and sewer system.

Tex., Leonard.—City votes Sept. 16 on $8000 bonds to construct water-works. Address The Mayor.

Va., Richmond.—Administrative Board instructed Supt. Trafford of electric plant to prepare specifications for electrically-driven pump to be added to present units at water pumping station; estimated cost, $5000; E. E. Davis, Supt. Water Dept.

WOODWORKING PLANTS

W. Va., West Augusta—Oil Barrels and Boxes.—Hardwood Package Co., 1428 S. Penn. Sq., Philadelphia, Pa., advises Manufacturers Record: Have tract of timber under option; cannot give definite information at present. (Hardwood Package Co., lately noted to cut timber, build railroad, etc.)

FIRE DAMAGE

Ala., Fort Payne.—J. B. Wood's residence.

Ark., Pine Bluff.—S. J. McCarra's store; Frank Lyons' apartment-house; loss $5000.

Fla., Winter Haven.—O. P. Branch's residence.

Ga., Americus.—U. R. and C. M. Murphy's gin; loss $4500.

Ga., Columbus.—Beehive department store, operated by Leo Loewenberz & Sols; loss about $20,000.

Ky., Carlisle.—James Archdeacon, Jr.'s store and residence; loss $5000.

La., Shreveport.—Dambly Building: Miss Dick Files' residence; Caddo Land Co. Ltd.'s building, occupied as rooming house by Ed. Oby; loss $30,000.

Md., Easton.—E. T. Warner's flour mill; loss $18,000.

Mo., Jefferson City.—Stock room of Central Broom Factory at State penitentiary; Elliott W. Major, Gov.

N. C., Roseboro. — Williams-McKeithan Lumber Co.'s planing mill; loss $10,000 to $15,000.

Okla., Chickasha.—J. B. Burton's barn; loss $4000 to $5000.

S. C., Camden.—Southern Ry. Freight depot; B. Herman, Ch. Engr., M. W. & S., Washington, D. C.

S. C., Fort Lawn.—S. M. McWatters' residence and two outbuildings.

S. C., Johnston.—J. D. Bartley's residence.

Tenn., Bristol.—A. J. Sheldon's garage; loss $12,000.

Tex., Corsicana.—Stroud-Dockum Wholesale Grocery Co.'s building; loss $35,000 to $40,000.

Tex., Eldorado.—Eldorado Mercantile Co.'s store building; loss $14,000.

Va., Ashland.—Charles Mallory's store and residence at Ellett's Crossing.

Va., Trevilians.—Lee Rosson's store and dwelling near Trevilians; loss $5000.

BUILDING NEWS

BUILDINGS PROPOSED

APARTMENT-HOUSES

Ga., Atlanta.—E. White will erect two 2-story frame apartment-houses; cost $18,300.

Mo., Kansas City.—McCanles Realty Co. will erect three flats; 3-stories; 6 suites; brick; cost $45,000.

Mo., Kansas City.—Thomas Gant will erect 2-story brick flat; cost $7000.

Mo., Kansas City.—Charles Miner will erect apartment-house; 4 suites; brick; cost $8500.

Tenn., Memphis.—J. A. Holley will erect apartment-house; 2 stories; brick veneer; 32 rooms; cost $10,000.

Tex., Dallas.—J. O. Crabtree will erect two-story apartment-house; cost $16,000.

Va., Newport News.—A. F. & A. M. opens bids Sept. 14 to erect Masonic Temple and apartment building. (See Association and Fraternal.)

Va., Norfolk.—L. H. Lowery, Law Bldg., will erect apartment-house; 15 suites; brick; 65x88 ft.; ordinary construction; gravel roof; wood floors; steam heat; bids received through Phillip B. Moser, Archt., 414 Dickson Bldg., Norfolk, until Sept. 12; plans at Builders' Exchange.

ASSOCIATION AND FRATERNAL

Tex., Brownwood.—B. P. O. E. has plans by L. Harrington Co., San Antonio, for lodge building; 2 stories; 42x120 ft.; brick; gravel roof; pine and maple floors; metal awnings; metal lath and plaster partitions; Mosaic tiling. Address Brooke Smith.

Tex., Yoakum.—Masonic Building Association, Inc., has plans by J. Henry Yentzen, Yoakum, for store and lodge building; ordinary brick; 50x100 ft.; composition roof; wood floors; cost $15,000; bids opened Sept. 11. Address Archt. (Lately noted.)

Va., Newport News.—A. F. & A. M. receive bids through Ferguson, Calrow & Wrenn, Archts., Virginia National Bank Bldg., Norfolk, until Sept. 14 to erect Masonic Temple and apartment building; 50x70x 25x100 ft.; brick and terra-cotta; Barrett specification roof; wood floors; steam heat; steel beams and columns; cost $50,000. (Previously noted.)

BANK AND OFFICE

Fla., Jacksonville.—J. J. Hamilton will erect office and cattle pens at Armour & Co.'s factory; cost $13,000.

Ga., Atlanta.—Gude & Co., Atlanta, have tentative plans for arcade building on site 2-8 Peachtree St., owned by Flynn Estate; 6 stories cost about $500,000.

Ga., Tifton.—Dr. N. Peterson, Ben McLeod, and others will erect office and business building at Love Ave. and Second St.; department store on first floor; offices above; brick and iron construction.

La., Shreveport.—E. A. Frost and others are having plans prepared for 1-story office building.

Md., Baltimore.—Merchants-Mechanics National Bank, South and Water Sts., has plans by Parker, Thomas & Rice, Union Trust Bldg., Baltimore, for 2-story brick addition 20x12 ft.; also interior remodeling of present structure to provide banking quarters for entire first floor, offices on upper floor, etc.; reported cost $50,000. (Previously noted.)

Okla., Sapulpa.—First National Bank is having plans prepared by W. M. Griffith & Sons, Sapulpa, for 3-story bank building; electric fixtures.

Okla., Tulsa.—Sinclair Oil & Gas Co. has plans by C. K. Birdsall, 1002 Commerce Bldg., Kansas City, Mo., for store and office building; 140x72 ft.; 8 stories; reinforced concrete; tar, gravel and tile roof; gypsum floor blocks; vacuum (2-pipe) heating system; cement sidewalks; cost $225,000; 2 elevators about $8500; bids opened about Oct. 1. Address Archt. (Lately noted.)

Tex., Paris.—City National Bank opens bids Sept. 12 to erect bank and office building; plans at office of Curtis, Broad & Lightfoot, Paris, and Lang & Witchell, Dallas, Archts.

CHURCHES

Fla., Avon Park.—First Baptist Church is having plans prepared by Bryan & Poteet, Lakeland, Fla., for building; cost $3500; plans ready about Oct. 1.

Fla., Fort Pierce.—Methodist Church will erect $20,000 building. Address The Pastor.

Ga., Fort Valley.—Methodist Church will erect $15,000 annex to building. Address The Pastor.

Ky., Louisville.—Virginia Avenue Baptist Church will erect brick building; cost $5000. Address The Pastor.

Okla., Laverne.—Methodist Church will erect parsonage. Address The Pastor.

Tenn., Memphis.—Greek Orthodox Church, Rev. Constantine Liacopulos, Pastor, will erect building; cost about $15,000.

CITY AND COUNTY

Ala., Montgomery—City Hall.—City votes Oct. 17 on $250,000 bonds for city hall. Address The Mayor. (Lately noted.)

Ga., Cartersville — Municipal. — City has plans by Edwards & Sayward, Atlanta, for municipal building; 40x100 ft.; ordinary construction; gravel roof; tile and wood floors; team heat; electric lights; bids opened Sept. 20. Address Paul Gilreath, Mayor. (Lately noted.)

Md., Baltimore—Mansion.—City will restore and renovate old Carroll Mansion at Lombard & Front Sts.; bids received by Board of Awards, at office Richard Gwinn, City Register, City Hall, until Sept. 13; J. J. Byrne, Inspector of Buildings.

Md., Westernport—Town.—Town, Harry F. Smith, Mayor, rejected all bids to erect town building. (Previously noted.)

Miss., Clarksdale — Jail. — County, S. F. Carr, Chancery Clerk, postponed erection of addition to jail. (Lately noted.)

Miss., Gulfport—Library. — City receives bids until Sept. 26 to erect Carnegie library; 43x51 ft.; ordinary pressed brick; composition roof; cost about $10,000; Nolan & Torre, Archts., 415 Hennen Bldg., New Orleans. (Previously noted.)

S. C., Florence—Jail.—J. B. McBride, County Supvr., receives bids until Sept. 21 (extended date), to erect brick and concrete jail; plans and specifications at office W. J. Wilkins & Co., Archts., Williamson Bldg., Florence. (Lately noted.)

Va., Petersburg—Convention Hall and Armory.—City plans to erect convention hall and armory. Address The Mayor.

Va., Richmond—Storehouse.—John E. Butler, Building Inspector, Room 316, City Hall, opened bids to erect city storehouse; 42,200 sq. ft., to include garage for 28 automobiles; City Engr.'s Dept., gas works, electrical and water departments; 68x225 ft.; 45 ft. high; 3 stories brick and concrete; fireproof; 5-ply slag on concrete slab roof; reinforced concrete floors; slag and tin roof; electric lights; cost $45,000; two electric elevators about $10,000; John T. Wilson & Co., Richmond, is lowest bidder at $58,377; Carneal & Johnston, Archts., 707 Chamber of Commerce Bldg., Richmond., will probably revise plans. (Lately noted.)

COURTHOUSES

Fla., St. Augustine.—St. Johns County Commrs. receive plans, specifications and estimate of cost, through County Clerk until Oct. 15 for repairs to burned courthouse.

DWELLINGS

Ala., Birmingham. — W. M. Cosby, 1501 Avenue A, will open bids about Oct. 1 to erect residence; brick veneer; tile roof; cost $15,000. (Lately noted.)

Ark., Little Rock.—D. D. Terry will expend $5000 to remodel residence.

Ark., Little Rock.—Mrs. Pearl Pepin has plans by John P. Almand, 1109 State Bank Bldg., Little Rock, for residence; 6 rooms; brick veneer; slate gravel composition roof; bids opened Sept. 7; cost $3000. (Lately noted.)

Fla., Jacksonville.—G. W. S. Bell will erect 2-story frame dwelling; cost $3000.

Fla., Jacksonville.—G. M. Boyd Co. will erect 2-story frame residence; cost $7400.

Fla., Sarasota.—Beresford Prior will erect residence.

Fla., Sarasota.—Chas. Gross, Chicago, will erect 2-story stucco residence on Sarasota Bay; A. C. Price, Archt., construction begun.

Ga., Atlanta.—J. E. DeMars, 522 Grant Bldg., will erect lately-noted residence; 6 rooms, bath and basement; brick veneer; shingle roof; cost $2500; hot-air furnace, $135; plans and construction by owner. (See Machinery Wanted—Building Materials.)

Ky., Louisville.—W. C. Beatty will erect 4 frame dwellings at 3519-3521 W. Madison St. and 842 and 848 Midway St.; cost $8100.

Md., Baltimore.—G. F. Buchholtz, 321 W. Monument St., has plans by J. R. Forsythe, 232 St. Paul St., Baltimore, for residence; 38x55 ft.; cost $6000; owner taking sub bids.

Md., Baltimore.—Chas. E. Litzinger has plans by F. E. Beall, 306 St. Paul St., Baltimore, for twelve 2-story dwellings at Park Drive and Remington Ave.; ten 13.8x46 ft., one 14.8x55 ft., one 13.9x50 ft.; steam or hot-water heat; cost $20,000 to $30,000; construction by owner.

Md., Baltimore.—Dr. Thomas Brown has plans by L. H. Fowler, 347 N. Charles St., Baltimore, for residence at Guilford; hollow tile-stucco; slate roof; concrete foundation; Willard E. Harn Co., 213 N. Calvert St., Baltimore, lowest bidder.

Md., Pikesville.—John C. Smith, 908 Maryland Trust Bldg., Baltimore, will erect bungalow.

Md., Sparrows Point.—Frank Novak, 2401 Harford Ave., Baltimore, purchased 210-acre site near Sparrows Point, including 1005 ft. on Eastern Ave., 3500 ft. on Sparrows Point electric line, 1537 ft. on O'Donnell St. and 2000 ft. on German Hill Rd.; will probably organize company and erect about 300 dwellings.

Mo., Kansas City.—D. J. Miller will erect 2 stucco-veneer dwellings; cost $5000.

Mo., Kansas City. — F. W. Metcalf will erect 2-story frame and stucco residence; cost $3400.

Mo., Kansas City.—E. C. Hallar will erect 2-story stucco-veneer residence; cost $5200.

Mo., Kansas City.—Mrs. Minnie Hurlbut will erect two 1-story frame dwellings; cost $3000.

Mo., Kansas City.—G. H. Shidler will erect 2-story stone-veneer residence; cost $3000.

Mo., Kansas City.—George Boden will erect two 1-story frame dwellings; cost $3000.

Mo., Kansas City.—E. V. Mittong will erect four 1½-story frame dwellings; cost $9800.

Mo., Kansas City.—Max Morris will erect two stucco-veneer residences; cost $8000.

Mo., Kansas City.—J. T. Johnson will erect residence; 2 stories; stucco; cost $3000.

Mo., Kansas City.—Zurn Building & Investment Co. will erect duplex residence; 24x56½ ft.; frame and stucco veneer; shingle roof; hot-water heat; cost $7000; plans and construction by owner. (Lately noted.)

N. C., Raleigh.—A. F. Guirkin, 1302 Hillsboro St. will erect five dwellings, lately noted; 6 to 9 rooms; frame; slate roof; oak floors; steam heat; electric lights; cost $3000. (See Machinery Wanted—Heating; Flooring; Electric Fixtures.)

Okla., Ardmore.—Harry Crockett will erect residence to replace burned structure.

Okla., Ardmore.—Mrs. Bertha Whiteman will rebuild burned residence.

Okla., Ardmore.—John S. Owens will erect 2-story, 10-room residence to replace burned structure.

Okla., Ardmore.—John Whiteman will erect residence to replace burned structure.

Okla., Muskogee.—C. C. Hultquist will erect $20,000 residence; electric lights.

Okla., Tulsa.—R. W. Tucker has plans by John V. Starr, Tulsa, for residence; hardwood trim and floors; hot blast heating system; bungalow type; bids being received; cost $4000.

S. C., Charleston.—Mrs. Harriet B. Tucker receives bids through Todd, Simons & Todd, Archts., 63 Broad St., until Sept. 14 to remodel residence; plans and specifications at office architects.

Tenn., Bristol. — Clifton Pendleton will erect brick bungalow.

Tenn., Newport.—Mrs. D. S. Robinson will erect 2-story brick-veneer bungalow; J. W. Lee, Archt., Newport.

Tenn., Dunlap. — S. B. Wilson, Cashier Sequatchie County Bank, will erect residence in West Dunlap to cost several thousand dollars.

Tenn., Nashville.—Geo. I. Waddey, Jr., will erect brick-veneer bungalow; cost $3200.

Tex., Brenham.—H. F. Wehmeyer has plans by M. M. Ginn for residence; 2 stories; brick veneer; colonial design; cost about $12,000.

Tex., Denton.—J. P. Sites will erect residence.

Tex., El Paso.—Max Weiler, owner of Alamogordo Marble Quarries will erect marble residence in Austin Terrace; 2 stories; 14 rooms; colonial style; cost $60,000.

Tex., Pleasanton.—J. K. Lawhon will erect residence on Lawhon estate.

Tex., Panhandle.—D. C. Stone has plans by C. Risser & Co., Amarillo, Tex., for residence; 7 rooms; frame; edge grain pine flooring; electric fixtures; owner will purchase materials; cost $3500.

Tex., Paris.—J. B. Shelton will erect 2-story brick veneer residence; cost $8700.

Tex., Quanah.—Dewitt T. Haden has plans by Field & Clarkson, Wichita Falls, to erect 2-story residence; tapestry brick; tile roof; oak floors; furnace heat; cost $15,000.

Tex., San Angelo.—S. H. Jones will erect 7-room residence.

Va., Richmond.—Thomas E. W. Launder will erect 2-story brick dwelling; cost $7500.

Va., Richmond.—W. T. Torrence will erect 2-story brick dwelling; cost $7000.

Va., Richmond.—P. J. Beattie will erect 2 semi-detached 2-story brick dwellings on Duval alley.

Va., Richmond.—Virginia Realty & Construction Co. will erect two 2-story brick dwellings on Ashland St.; also four brick garages in rear 219 N. Boulevard; cost $4000.

Va., Richmond.—R. F. Childress will erect 2-story frame dwelling; cost $4000.

W. Va., Parkersburg. — Mrs. Virginia Wright will erect bungalow.

W. Va., Point Pleasant.—Rush Burnside will erect residence.

GOVERNMENT AND STATE

Ky., Frankfort—Capitol.—State Sinking Fund Commission will probably let contract at $4370 to Capital Lumber & Manufacturing Co., Frankfort, for repairs to and installing heating plant in capitol.

HOSPITALS, SANITARIUMS, ETC.

Miss., Ellisville.—Jones County voted $20,000 bonds for South Mississippi Charity Hospital. Address County Commrs.

N. C., Greenville—Pitt County votes Dec. 5 on erection of $50,000 hospital. Address County Commrs.

S. C., Greenville.—City, C. S. Webb, Mayor, votes Sept., 26 on $60,000 bonds to supplement $40,000 already available to erect hospital. (Lately noted.)

Tex., Snyder.—Company organized with R. G. Davenport, Prest., and H. E. Rosser, Secy., plans to erect sanitarium.

Tex., Temple.—Colored Baptist Church purchased site and plans to erect sanitarium; Rev. Mr. Wilson, Pastor.

W. Va., Terra Alta.—State Board of Control, Jas. S. Lakin, Prest., Charleston, rejected all bids to erect tuberculosis sanitarium; will have plans revised and ask for new bids. (Lately noted.)

HOTELS

Fla., Jacksonville.—Hotel Jackson, John G. Haydock, Mgr., will remodel interior of building; install furniture, etc.

Fla., Sarasota.—A. L. Hough, 519-22 Washington Loan and Trust Bldg., Washington, D. C., and others are interested in erecting $1,000,000 hotel; work to begin at once.

Fla., Seminole.—Hotel Seminole, Chas. G. Day, Mgr., will improve building; install fixtures; repaper, etc.; let contract for tile floors for parlors.

Okla., Henryetta.—J. H. Campbell has plans by John V. Starr, Tulsa, for addition to Hotel Georgian; day labor; cost $10,000; owner will purchase materials.

Tenn., Newport.—Herbert E. Fine and others plan to erect 60-room hotel at Carson Springs.

MISCELLANEOUS

Ark., Little Rock—Clubhouse.—F. B. T. Hollenberg will erect clubhouse for Pulaski County Boys' Club; J. S. Maloney and W. E. Woodruff are interested.

Fla., Jacksonville—Cattle Pens.—J. J. Hamilton will erect cattle pens at Armour & Co.'s factory. (See Bank and Office.)

Okla., Nowata—Fair.—Nowata Retail Merchants Assn. will erect building for Nowata County Free Fair; 50x100 ft.

Okla., Muskogee—Barn.—F. A. Gillespie has plans by John V. Starr, Tulsa, for barn; 64x165 ft.; concrete; composition roof.

Tex., Corsicana—Clubhouse.—Fish Tank No. 2, Fishing and Hunting Club, will erect clubhouse.

RAILWAY STATIONS, SHEDS, ETC.

Fla., Lake Wales.—Atlantic Coast Line R. R., J. E. Willoughby, Ch. Engr., Wilmington, N. C., will erect 25-ft. addition to freight station.

Tex., Austin.—St. Louis, Iron Mountain & Southern Ry., E. A. Hadley, Ch. Engr., St. Louis, will erect depot; 18x60 ft.

SCHOOLS

Ala., Eufaula.—City votes Sept. 18 on $15,000 school improvements; Frank Lockwood, Archt., Montgomery, Ala. (Previously noted.)

Ala., Montgomery.—City votes Oct. 17 on $25,000 bonds for school buildings and improvements. Address The Mayor.

Ark., Center Point.—School Board will erect school building; J. J. Roberts, Princ.

Ark., Monette.—Hancock Dist. School Board, Thos. Riddle, Chrmn., will soon let contract to erect frame school.

Fla., Myakka City.—Manatee County School Board, Bradentown, Fla., has plans by A. C. Price, Sarasota, Fla., for school: 2 stories; 4 rooms; tin or sheet iron roof; cost $5000. (Lately noted.)

Fla., Ellenton.—School Board has plans by A. C. Price, Sarasota, Fla., for school; ordinary construction; brick; heating plant; cost $18,000. Address Archt.

Miss., Kewanee. — Kewanee Consolidated School Dist. votes Sept. 30 on bonds for school. Address Dist. School Trustees.

Miss., Summit.—Pike County School Board, Magnolia, Miss., is reported to have selected Godbold Wells as location for proposed agricultural high school.

Mo., Carthage.—Board of Education, Nora Johnson, Secy., receives bids until Sept. 22 to erect two grade schools; J. H. Felt & Co., Archts., 800 Grand Avenue Temple, Kansas City, Mo.

Mo., Mercer.—Mercer Dist. School Trustees, W. H. Lowry, Secy., receive bids until Sept. 11 to erect school; plans and specifications at office David G. Fisher Architect Co., Davenport, Iowa.

Okla., Holdenville.—School Board is having plans prepared for school building.

Okla., Wann.—School Dist. No. 7, C. C. Fitzsimmons, Clk., will erect school; G. A. Henderson, Archt., Coffeyville, Kan.

S. C., Gaffney.—Limestone College, Dr. Lee Davis Lodge, Prest., will erect library building, science hall, music hall and gymnasium; R. C. Black, landscape gardner, Gaffney, prepared plans and is supervising work on college campus including quarter of mile lake; sand-clay and graveled walks and drives.

Tenn., Murfreesboro.—City votes Sept. 18 on $75,000 bonds to erect high school and two grammar schools; G. B. Giltner, Mayor.

Tex., Cedar Hill.—Bear Creek Dist. School Board will erect 1-story school; bids opened Sept. 7; Address Tom Chester, Cedar Hill, Route No. 1.

Tex., Dunn.—Dunn School Dist. Trustees will erect additional story to building.

Tex., Houston.—Harris County Commrs. plan to include $67,500 appropriation in 1916-17 budget for fireproof brick building for Harris County School for Girls at Bellaire.

Tex., Marlin.—School Board is having plans prepared by C. D. Hill & Co., Dallas, for high school; cost $60,000.

Tex., Polytechnic.—City Commission ordered vote Sept. 30 on $20,000 bonds to erect school; 2 stories; fireproof; mill construction; yellow pine floors; jacketed stoves; city lighting; Taylor & Leake, Archts., Paris, Tex. (Lately noted.)

Tex., Swenson.—Swenson Dist. School Board will erect 2-story school building. Address C. E. Brannan.

W. Va., Grafton.—School Board, W. M. Feltner, Secy., receives bids until Sept. 16 to erect 3-room school at Wendel; plans and specifications at H. C. Davis' store, Simpson, W. Va., and office W. M. Feltner, Grafton, Route No. 8.

W. Va., Morgantown.—State Board of Control, Jas. S. Lakin, Prest., Charleston, W. Va., opens bids about Nov. 1 to erect dormitory, 220x43 ft., and agricultural building, 188x64 ft., at West Virginia University; brick, stone and terra-cotta; slate and slag roof; concrete, tile and wood floors; electric and gas lighting; steam heat; cost $300,000; Paul A. Davis, 3rd, Archt., 1713 Sansom St., Philadelphia. Address Jas. S. Lakin as above. (Previously noted.)

STORES

Ark., Decatur.—C. L. Miller will erect concrete business building.

Ark., Little Rock.—Alex. M. Keith will remodel 2-story brick store building at 400-02 Main St.; cost $10,000.

Fla., High Springs.—W. C. Summers will erect business building; 50x60 ft.; brick on concrete foundation; electroid rubber roofing; yellow pine floors; ordinary wood heaters; cost $3500 to $4000; electric lights; plans and construction by owner.

Fla., Jacksonville.—R. Buffalow will erect brick addition to building at First St. and Atlantic Coast Line Ry.; cost $8000.

Ga., Atlanta.—Henry S. Jackson has plans by A. Ten Eyck Brown, Forsyth Bldg., Atlanta, for store and loft building at 191 Peachtree St.; mill construction; composition roof; wood floor; low-pressure steam heat (public service); automobile lift; bids opened about Sept. 15. (Noted in July.)

Ga., Tifton.—Dr. N. Peterson and others will erect store and office building. (See Bank and Office.)

Okla., Clinton.—T. D. Turner & Co. will erect brick and concrete business building.

Okla., Tulsa.—J. J. Culbertson will erect 1-story store building on Boulder and Fourth Sts.; 100x100 ft.; plans 10-story structure later.

Okla., Tulsa.—Sinclair Oil & Gas Co. will erect store and office building. (See Bank & Office.)

Okla., Weatherford.—C. A. Thacker will erect brick business building.

Tenn., Chattanooga.—J. T. Lupton will expend $3000 for repairs to building on Market St.

Tenn., Shelbyville.—J. B. Marsh will erect store building at Main and Lane Sts.

Tex., Childress.—Dr. J. W. Albert will erect brick business building to be occupied by Gray & Sloan.

Tex., Dallas.—Frank Witchell is reported to expend $8000 to reconstruct front of building.

Tex., Paris.—Wortham & Collins will erect 2-story brick business building; cost about $16,000.

Tex., Tyler.—Dr. Goodman has plans by Bothwell & Shaw, Tyler, to remodel 2-story business building; 60x100 ft.; brick; architects will purchase materials.

Va., Newport News.—M. O. Lackey will erect brick store building.

Va., Richmond.—M. T. Burke has option on site at Twelfth and Hull Sts.; plans to erect 2-story department store to be occupied by Hutzler & Co.; 68x90 ft.; cost $20,000.

THEATERS

Md., Baltimore.—Nixon Victoria Theater Co. will be incptd. with $50,000 capital by Fred. G. Nixon-Nirdlinger Co., Philadelphia, and others; leased Victoria Theater and will expend $20,000 to $25,000 to remodel; enlarge stage; install new seats; remodel interior and exterior.

Mo., Joplin.—Frank H. Braecle, Chas. Turner, Dr. C. M. Baisley, and others will organize company and enlarge Royal Theater to provide seating capacity of 1500; cost $35,000.

Tenn., Chattanooga.—Signal Amusement Co. will remodel Alcazar Theater; rebuild auditorium; increase seating capacity to 1150; construction begins in about 2 weeks.

WAREHOUSES

Fla., Manatee.—Wilson & Toomer will erect fertilizer warehouse.

N. C., Durham.—E. G. Davis will erect warehouse to be occupied by L. R. Carter.

Tex., Dallas.—Louis Blaylock will erect warehouse at 2022 Jackson St. for Willard Storage Battery Co. of Texas, incptd. with $20,000 capital; 50x150 ft.; completion by Nov. 1; temporary location 2120 Main St.

Tex., Houston.—Sanders & Co. will erect cotton sheds; cost $3000.

Tex., Wichita Falls.—Wichita Valley Refinery Co. will erect barrel warehouse; brick; 36x72 ft.; fireproof.

Va., Richmond.—D. Moschetti will erect 2-story brick store building.

Va., Richmond.—J. G. McCrory Co., New York, is reported to erect building at 11th and Hull Sts.

BUILDING CONTRACTS AWARDED

APARTMENT-HOUSES

D. C., Washington.—W. S. Minnix has plans by and let contract to A. C. Minnix, 1416 F St. N. W., Washington, to erect apartment-house; 35x142.5 ft.; brick and concrete; reinforced concrete and slag roof; combination reinforced concrete and tile floors; cost $40,000; vapor heat, $3000; electric lights, $1000. (Lately noted.)

Fla., Miami.—Dr. Carleton Vaughan, Fort Dallas Park, Miami, let contract to W. E. Martin, Miami, to erect apartment-house; 32x61.6 ft.; reinforced concrete and hollow tile; composition flat roof with tile trimmings; wood floors; city electric lights; cost $10,000; August Geiger, Archt., Townley Bldg., Miami. (Lately noted.)

Fla., St. Petersburg.—C. R. Reese let contract to Beard-French Co., St. Petersburg, to erect apartment-house; 2 stories; 4 suites; completion in 6 weeks.

ASSOCIATION AND FRATERNAL

Ga., Columbus.—Rose Hill Lodge No. 480, I. O. O. F. let contract to Butts Lumber Co., Columbus, to erect lodge building; 3 stories; 40x75 ft.; metal roof; concrete floors; Chas. F. Hickman, Archt., Columbus. Address T. Hicks Fort, member of Bldg. Co. (Lately noted.)

BANK AND OFFICE

Ky., Covington.—German Mutual Fire Insurance Co., 625 Madison Ave., let contract to John J. Craig, Covington, to erect store and office building; 3 stories; concrete; composition roof; wood and terrazzo floors; cost $90,000; Samuel Hannaford & Sons, Archts., Cincinnati. (Lately noted.)

Md., Baltimore.—Western Maryland Dairy Co. let contract to G. Walter Tovell, Eutaw and McCulloh Sts., Baltimore, to erect office building at Linden Ave. and Dolphin St.; 2 stories; 24x150 ft.; stucco.

Tex., Dallas.—J. C. O'Connor Estate (L. A. Pires and E. O. Tenison, representatives) let following contracts to erect building at 1303 Main St. for Dallas Trust & Savings Bank: At $81,000 to Watson Co., general contract; Hamilton Co., heating; Harry Kahn, plumbing, all of Dallas; Otis Elevator Co., New York, to install elevator; structure to be 3 stories and basement; exterior medium ivory polychromic terra-cotta; fireproof; cost, including fixtures, vault lining and doors, which are to be let later, $100,000; Hubbell & Greene, Archts., Dallas. (Lately noted.)

Va., Harrisonburg.—People's Bank let contract to E. W. Minter Co., 115 Broadway, New York, to erect building; 5 stories; high-speed electric elevator; Indiana limestone and face brick; Alfred C. Bossom, Archt., 366 Fifth Ave., New York. (Previously noted.)

CHURCHES

Ark., Batesville.—Episcopal Church let contract to Wm. Bingle, Newport, Ark., to erect building; 54x98 ft.; broken ashlar and limestone; slate roof; concrete and pine floors; electric lights; cost $16,000; hot-water heat, $1200; Chas. L. Thompson, Archt., Little Rock, Ark.

Ark., Corning.—Methodist Episcopal Church let contract to Tomlinson & Hale, Heber Springs, Ark., to erect building; brick; metal shingle roof; double wood floors; electric lights; cost $12,000; steam heat, about $1200; concrete sidewalks, $150; E. M. Weems, Archt., Paragould, Ark. (Lately noted.)

Ark., Pottsville.—Associate Reformed Presbyterian Church let contract to C. B. Wilkins, Atkins, Ark., to erect $6500 building.

Ark., Walnut Ridge.—Presbyterian Church let contract to T. I. Young, to erect building; brick; cost $5000; John P. Almand, Archt., Little Rock, Rev. G. C. Currie, Pastor. (Previously noted.)

Mo., St. Louis.—Calvary Baptist Church, Rev. J. N. Wynn, pastor, 5014 Alcott Ave., will erect chapel; brick; 40x64 ft.; basement; auditorium, 40x40 ft.; stone and brick; shingle roof; pine and hardwood floors; steam heat; electric lights; cost $5000; concrete walks $50; J. M. Pendleton, Archt.; Murch Bros., Contrs., both of St. Louis.

N. C., Charlotte.—First Presbyterian Church let contract to Blythe & Isenhour, Charlotte, to erect Sunday-school building; 60x60 ft.; brick and wood; slate roof; wood floors; cost $35,000; J. M. McMichael, Archt., Charlotte. Address Contrs. (Lately noted.)

Tenn., Nashville.—Woodland Presbyterian Church let contract to J. W. Patrick & Co., 300½ Church St., Nashville, to erect building; stone veneer; 80x132 ft.; slate and tile roof; oak floors; steam heat; indirect electric lighting; cost $50,000; C. K. Colley, Archt., 33-40 Life & Casualty Bldg., Nashville. (Noted in July.)

Tex., Denton.—First Baptist Church, Rev. F. H. Watkins, pastor, let contract to Overall & Naugle, Denton, to erect parsonage; cost $3000.

Tex., Sulphur Springs.—Methodist Church let contract to Jno. Westbrook, to erect building; cost $36,000. Address The Pastor.

CITY AND COUNTY

Tex., Dallas — Comfort Stations. — Park Board let contract to J. W. Bryan, Dallas, to erect public comfort stations in Ekall and Cliff parks; cost $4000; wiring contract let to J. W. Johnson, Dallas. (Lately noted.)

Tex., Houston—Shelter House.—City let contract to Ness & Tellepson, Houston, to erect shelter house in Elizabeth Baldwin Park cost $3400.

COURTHOUSES

Tex., Wichita Falls.—Lisle Dunning Construction Co., Oklahoma City, general contractor to erect courthouse, let following additional sub-contracts: A. E. Maidt, Oklahoma City and W. L. Beatty, Wichita Falls, plastering; Hugh L. Turner, Oklahoma City, sheet metal and tile roof; plans by Field & Clarkson, Wichita Falls and Sanguinett & Staats, Fort Worth, call for structure 80x200 ft.; 3 stories; reinforced concrete, brick, stone and terra-cotta; fireproof; concrete slab floors; tile roof; vacuum steam heat. (Other contracts previously noted.)

W. Va., Madison.—Boone County Commrs. let contract to Minotti & Bennett, Danville, W. Va., to erect courthouse; stone (imported) construction; cost $98,000; H. Rus Warne, Archt., Charleston, W. Va.; votes Sept. 29 on $50,000 bonds for courthouse. (Lately noted.)

DWELLINGS

Fla., Myakka City.—J. Zachar let contract to L. H. Price, to erect bungalow; special electric light and water plant. Address A. C. Price, Supervising Archt., Sarasota.

Ga., Augusta.—John Sancken let contract to Lawrence Construction Co., Augusta, to erect residence; hollow tile stuccoed; slate roof; wood floors; electric lights; heating not determined; cost $9000; Phil. P. Scroggs, Archt., Augusta. Address contractor. (Lately noted.)

La., New Orleans.—Savings & Homestead Assn. let contract to W. R. Gilbert, New Orleans, to erect $3500 residence.

La., New Orleans.—Walter J. McNamara let contract to Carlos E. Grevemberg, to erect residence; cost $3750.

Md., Baltimore.—A. K. Wampole, 725 St. Peter St., let contract to Roland Park Co., Roland Park, Md., to erect 2½-story brick residence at Guilford; Mott B. Smith, Archt., 15 E. Fortieth St., New York.

Md., Baltimore.—H. D. Eidman let contract to Wm. E. Bounds, 2212 Elsinore Ave., Baltimore, to erect five 2-story dwellings on Gold St.; 13x42 ft.; hot-air heat; cost $8000; F. F. Beall, Archt., 306 St. Paul St., Baltimore. (Lately noted.)

Md., Baltimore.—A. K. Wampole, Lake Ave., let contract to Roland Park Co., Roland Park, Md., to erect dwelling at Whitefield Rd. near Charles-St. Ave.; 106x30 ft.; brick and hollow tile; slate roof; wood floors; cost $24,000; M. B. Schmidt, Archt., 15 E. 40th St., New York.

Md., Salisbury.—Dr. Geo. W. Jarman let contract to D. E. Parker and Twilley Malone, Salisbury, to erect residence on Wicomico Creek; 24x50 ft.; frame and shingle; shingle roof; hardwood floors; heating not decided; cost $12,000; Owens & Sisco, Archts., 1604 Continental Bldg., Baltimore, may be addressed.

Mo., Kansas City.—Saml. W. Moore, First National Bank Bldg., let contract to Long Construction Co., Rialto Bldg., Kansas City, to erect residence; 47x61 ft.; frame stucco; wood joist floors; cost about $22,000; vacuum steam heat, $1200; city electric lights; wiring, $250; John Van Brunt, Archt., 408 Republic Bldg., Kansas City. Address contractor. (Lately noted.)

Okla., Oklahoma City.—J. A. Foresman let contract to Stewart & Wilderson, American Bank Bldg., Oklahoma City, to erect residence; 36x16 ft.; frame; shingle roof; pine and oak floors; cost $4500; Maurice Jayne, Archt., Oklahoma City. (Lately noted.)

S. C., Fort Mill.—Fort Mill Mfg. Co. let contract to Fort Mill Lumber Co., Fort Mill, to erect 25 cottages; 3, 4 and 5 rooms each; wood; shingle roofs; wood floors; cost $500 to $800 each. Address J. J. Bailes. (Lately noted.)

S. C., Riverside.—Riverside Mills let contract to Builders' Lumber & Supply Co., Anderson, S. C., to erect three 6-room and seven 4-room cottages for operatives.

Tenn., Memphis.—Dr. A. F. Cooper is reported to have let contract to Edward Miles, Memphis, to erect residence; 2 stories; 8 rooms; brick veneer; cost $6500.

Tenn., Memphis.—J. M. Dean let contract to erect store and dwelling. (See Stores.)

Tenn., Nashville.—A. C. Ottarson let contract to Jas. Kerr, Nashville, to remodel residence; cost $3500; Marr & Holamn, Archts., Nashville. (Lately noted.)

Tenn., Nashville.—Dr. Marvin McFerrin let contract to Jas. Kerr, First St., Nashville, to erect residence; 30x62 ft.; wood construction; metal roof; cost $3500; Marr & Holman, Archts., Nashville. (Lately noted.)

Tex., Pleasanton.—S. E. Ricks let contract to erect residence on Main St.

Tex., Paris.—Mrs. C. M. Pettus let contract to C. G. Caviness, Paris, to erect residence; 2 stories; 6 rooms; frame; 28x35 ft.; tapestry brick; tin shingles; yellow pine floors; gas and electric fixtures; cost $3500; contractor will purchase materials; Geiger, Faught & Macklin, Archts., Paris. (Previously noted.)

W. Va., Martinsburg.—Dwight Sprinkle let contract to George Keyton to erect residence in Boyd Ave.

W. Va., Parkersburg.—Mrs. Sophia Poole let contract to R. L. Brown, Parkersburg, to erect 3-story brick residence; 44x140 ft.; cost $30,000; R. H. Adair, Archt., Parkersburg.

GOVERNMENT AND STATE

Ga., Macon—Postoffice.—Algernon Blair, Montgomery, Ala., has contract for lighting and constructing "swing room", portion of addition to federal building; cost $3000; Custis Nottingham, Postmaster. (Lately noted.)

HOSPITALS, SANITARIUMS, ETC.

Md., Baltimore.—Painter Memorial Hospital, Green Spring Ave., has plans by Ellicott & Emmart, Union Trust Bldg., and let contract to Gladfelter & Chambers, 729 Roland Ave., both of Baltimore, to erect addition; cost $5000.

N. C., Mt. Airy.—Dr. Moir S. Martin let contract to T. D. Roberts to erect addition to hospital; 15 rooms; granite; slate roof; hardwood floors; electric lights; passenger elevator; dumb waiter; cost $7000; hot water heat, about $1050; D. H. Cook, Archt., Mt. Airy. Address Dr. Martin.

HOTELS

Okla., Chickasha.—Julian F. Burtschi, Decatur, Ill., let contract to O. F. Back to remodel 3-story 42-room hotel; 75x100 ft.; materials will include millwork, steel I-beams; marble, wirework, metal ceiling; 2 skylights; electric and gas fixtures; 4 bathtubs; 4 washstands; heating plant; elevator, etc.; cost $16,000; L. P. Larsen, Archt., Chickasha, will do buying. (Previously noted.)

Tex., El Paso.—Z. T. White let contract to R. E. McKee, El Paso, to erect hotel and business building; 3 stories; 40x120 ft.; brick; Barrett specification roof; metal ceiling; steam heat; will install 12 bathtubs, 30 washstands, etc.; cost $21,000; contractor will purchase materials; Trost & Trost, Archts., El Paso. (Lately noted.)

MISCELLANEOUS

Okla., Okmulgee—Fair.—E. B. Reed has contract to erect fair buildings.

S. C., Judson.—Judson Mills, Greenville, S. C., let contract to W. M. Jordan, Greenville, to erect community building and school; 3 stories; 50x96 ft.; brick veneer; lower floor, nurses' offices, offices for welfare work, sewing and cooking classes; second floor, 6 classrooms; upper floor, auditorium; cost $10,000; F. G. Rodgers, Archt., Greenville.

Tenn., Nashville—Stable.—J. W. Napier let contract to John Moore, 8th Ave. S., Nashville, to erect stable on Lea Ave.; 80x100 ft.; wood; Cary asbestos roof; concrete floors; cost $7500; Marr & Holman, Archts., Nashville. (Lately noted.)

RAILWAY STATIONS, SHEDS, ETC.

Ga., Tifton.—Atlantic Coast Line R. R., J. E. Willoughby, Ch. Engr., Wilmington, N. C., and Georgia, Southern & Florida Ry., J. A. Griffin, Engr. M. and S., Macon, Ga., let contract to Little & Phillips, Cordele, Ga., to erect union passenger station; single struction.

SCHOOLS

Ark., Garland.—Trustees let contract to H. Lehman and F. Body, Texarkana, Ark., to erect brick school.

Ark., Omaha.—Special School Dist. of Omaha No. 61 let contract to J. B. Reeves, Green Forest, Ark. to erect school; 41x68 ft.; brick; tar and gravel roof; wood floors; two hot-air furnaces; cost about $7000 complete. (Lately noted.)

Md., Barton.—Board of Education, Cumberland, Md., let contract to W. C. Schramm Co., Barton, to erect school addition; 34x68 ft.; mill construction; brick walls; stone foundation; wood floors; heating and lighting from present plants; cost $8000. Address Contr. (Lately noted.)

Md., Cambridge.—Board of Education let contract to Thomas & Brohawn, 218 Race St., Cambridge, to erect schools in East Cambridge and on Peach Blossom St.; 85x45 ft. and 54x37 ft.; brick; slag roof; wood floors; steam heat; electric lights; cost $18,000; Wallace E. Hance, Archt. Address Contractors. (Previously noted.)

N. C., Ahoskie.—School Board let contract to M. R. Herring, Winton, N. C., to erect high-school auditorium building; brick construction; brick and concrete; asbestos shingle roof; tile floors; electric lights; cost $25,000; G. M. Poley, Archt., Wilmington, N. C. (Lately noted.)

N. C., Durham.—Durham County Board of Education, C. W. Massey, Supt., let contract to A. C. Hamilton, Durham, to erect school at Reservoir; 2 rooms; completion Nov. 1. (Lately noted.)

N. C., Hendersonville.—School Board let contract to Allard Case, Hendersonville, to erect negro school building. (Previously noted.)

N. C., Mt. Holly.—Board of Education let contract at $9900 to R. F. Rankin, Mt. Holly, to erect school; 60x84 ft.; 2 stories; brick; slate roof; wood floors; electric lights; steam heat from boiler in old building; F. L. Bonfoey, Archt., Charlotte. Address Contr. (Previously noted.)

N. C., Poplar Branch.—County, R. D. Isley, Supt. of Schools, Currituck, N. C., let contract to A. G. Page, Elizabeth City, N. C., to erect high school; 96x59.5 ft.; frame shingle roof with composition on deck; wood floors; cost $10,200; steam heat, about $1200; Chas. C. Hook, Archt., Charlotte, N. C. Address Contr. (Previously noted.)

S. C., Judson.—Judson Mills, Greenville, S. C., let contract to erect school and community building. (See Miscellaneous.)

Tex., Jewett.—School Board let contract to Murphy & Croft, Mineral Wells, Tex., to erect school; brick; steel ceiling; tar and gravel roof; contractor will purchase materials; cost $7200; Glenn Bros., Archts., Fort Worth.

Tex., Marlin.—School Board let contract to Caddo Construction Co. to erect Industrial High School; tar and gravel roof; wood floors; steam heat; cost $5541.70; F. E. Robertson, Archt., 1407 S. W. Life Bldg., Dallas.

STORES

Ala., Ensley.—Ensley Land Co. let contract to C. M. Allen, Birmingham, to erect building to contain 5 stores; 135x100 ft.; brick; tar and gravel roof; cement and tile floors; construction begun. (Lately noted.)

Fla., Tampa.—S. H. Kress & Co., 350 Broadway, New York, will erect 2-story addition in rear of present structure; E. W. Parker, Contr., Tampa.

Ga., Atlanta.—Chamberlin-Johnson-DuBose Co., let contract to Gude & Co., Atlanta, to erect department store building; 100x190 ft.; reinforced concrete; tar and gravel roof; general plans not completed; cost $140,000; Morgan & Dillon, Archt., Atlanta. Address Contrs. (Lately noted.)

Ky., Covington.—German Mutual Fire Insurance Co. let contract to erect store and office buildnig. (See Bank and Office.)

Okla., Lawton.—Paynter-McVicker Grocery Co. let contract to Mr. Diehl to erect business building; 2 stories and basement; 66x150 ft.; 27,000 sq. ft. floor space; completion by Jan. 1.

Okla., Ringling.—F. E. Fagerquist let contract to Adams & Fudge, to erect store building; 25x100 ft.; 2 stories; brick; tar and gravel roof; concrete floors; gas heating and lighting; plans by owner. (Lately noted.)

Tenn., Memphis.—Mrs. Irene R. Turley let contract to R. F. Creson, Builders' Exchange, Memphis, to erect 2-story brick and marble front building on Gaston Hotel site; cost about $20,000; construction begins about Oct. 1; Chas. O. Pfeil, Archt., Tennessee Trust Bldg., Memphis.

Tenn., Memphis.—Ellis-Jones Co. let contract to E. Abele, Memphis, to remodel building on N. Court St.; cost $10,000; G. M. Shaw & Co., Archts., Memphis. (Lately noted.)

Tenn., Memphis.—J. M. Dean let contract to J. B. and L. E. Moody, Memphis, to erect store and dwelling; 2 stories; 8 rooms; frame and stucco; cost $3500.

Tex., Cleburne.—A. J. Wright has plans by and let contract to H. D. McCoy, Cleburne, to erect lately-noted mercantile building; 2 stories; 90x210 ft.; ordinary construction; gravel roof; wood floors; vacuum vapor heat; conduit lighting system; cement walks; freight elevator; cost $30,000. (See Building Materials — Heating; Plumbing; Wiring; Sprinkler System; Iron and Steel Work; Elevator.)

Tex., Dallas.—Central Real Estate Co. let contract to M. A. Faber to erect 2 brick buildings, each 60x100 ft., containing 6 store rooms; 1 story; white glazed brick; cost $24,000; Woerner & Cole, Archts., Sumpter Bldg., Dallas. (Lately noted.)

Tex., El Paso.—T. J. Beall let contract to Beaudelt & Cropper, El Paso, to erect business building; 2 stories; 40x196 ft.; pressed brick; gravel roof; steam heat; electric fixtures; cost $30,000; Braunton & Leibert, Archts., El Paso

Tex., El Paso.—Z. T. White let contract to erect store and hotel building. (See Hotels.)

Tex., El Paso.—Harry Turner let contract to W. J. Pickering, El Paso, to erect business building; 2 stories; 25x120 ft.; pressed brick; tar and gravel roof; cost $15,000; Braunton & Leibert, Archts., El Paso.

Tex., Ennis.—J. A. Tims let contract to erect 1-story brick business building; marble and plate-glass front.

Tex., Mexia.—Robertson & Bass let contract to J. F. Denning, Mexia, to erect brick business building.

THEATERS

Okla., Ardmore.—Princess Theater Co. let contract to Stiles Construction Co., Chicago, to erect theater; 3-story front; white tile and buff brick; seating capacity 1200 with balcony and gallery.

WAREHOUSES

Ky., Lexington.—Van Deren Hardware Co. let contract to S. F. McCormick Lumber Co., Lexington, to erect warehouse; 96x99 ft.; mill construction; composition roof; wood floors; cost $30,000; elevator, $1000; John V. Moore, Archt., Lexington. (Lately noted.)

Tex., Sherman.—Sherman Manufacturing Co. let contract to Wood & Elliott, Sherman, to erect fireproof warehouse; 100x200 ft.; cost $15,000.

MACHINERY, PROPOSALS AND SUPPLIES WANTED

Manufacturers and others in need of machinery or supplies of any kind are requested to consult our advertising columns, and if they cannot find just what they wish, if they will send us particulars as to the kind of machinery or supplies needed we will make their wants known free of cost, and in this way secure the attention of manufacturers and dealers throughout the country. The Manufacturers Record has received during the week the following particulars as to machinery and supplies wanted.

"WANTS"

Automobile Supplies.—See Hardware, etc.—W. C. Sanders.

Automobiles.—See Mining Machinery, etc.—Compania de Importacion.

Board (Wall, Wood Fiber).—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on 35,000 sq. ft. 4-ft.-wide, wood fiber, wall board, Schedule 108, delivery Washington.

Boiler (Locomotive).—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—100-150 H. P. locomotive boiler, capacity not less than 125 lbs. steam.

Boiler (Steam).—John M. Murch, County Auditor, Galveston, Tex.—Bids in duplicate until Sept. 20 to furnish and install 70 H. P. steam boiler in basement of Galveston County Courthouse; copies of specifications obtainable from County Auditor.

Boilers.—Hackley Morrison, P. O. Box 120, Richmond, Va.—4 to 6 H. P. vertical boiler and 8 to 10 H. P. vertical boiler; second-hand; first-class condition.

Boilers.—John G. Duncan Co., 308 W. Jackson Ave., Knoxville, Tenn.—Dealers price on 150 H. P. 125 pounds working pres-

sure, or 150 pounds water pressure tube and return tubular boilers; also on 100 H. P. locomotive or Scotch marine boilers and on 125-50 H. P. Scotch marine boilers.

Bottling Machinery.—Evans' Gardens, Dover, Fla.—Addresses of manufacturers of bottling machinery for small plants.

Bridges.—Pendleton County Commrs., Franklin, W. Va.—Bids until Sept. 25 to construct two bridges; information obtainable from State Road Bureau, Morgantown, W. Va.

Bride Construction.—See Road and Bridge Construction; State Roads Co., Baltimore, Md.

Bridge Construction.—Kanawha County Court, M. P. Malcolm, Prest., Charleston, W. Va.—Bids until Oct. 7 to construct highway bridge across Campbell's Creek under bridge of Kanawha & Michigan R. R. on north side of Kanawha River near Dana, Maiden Dist.; plans, profiles and specifications on file with F. G. Burdett, County Road Engr.

Bridge Construction.—Sussex County Commrs., Sussex, Va.—Bids until Sept. 21 to construct steel bridge 37 ft. long over Spring Swamp; plans and specifications on file with County Clerk, Sussex, and with G. P. Coleman, State Highway Commr., Richmond, Va.

Bridges (Steel).—Gaston County Commissioners., O. B. Carpenter, Clk., Gastonia, N. C.—Will let contract Oct. 5 to erect two steel bridges across South Fork river; one at Worth (or Harden); other at Vestal Ford, near Dallas; salvaged steel located on banks at places of erection to be used and figured in bids.

Bucket (Concrete).—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—Ransome concrete tower bucket, 30 cu. ft.

Building Materials.—J. E. DeMars, 522 Grant Bldg., Atlanta, Ga.—Prices on building materials for $2500 residence.

Building Materials.—H. D. McCoy, Cleburne, Tex.—Prices on heating, plumbing, wiring, sprinkler system; iron and steel work; plate glass; millwork; freight elevator, etc., for $30,000 mercantile building.

Canvas.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on cotton canvas, Schedule 132, various deliveries; 41,200 yds. 28-in. cotton canvas, Schedule 110, delivery Norfolk; 6000 yds. 72-in. cotton canvas, Schedule 133, delivery Philadelphia; 100,000 yds. 28½-in. slate color, cotton canvas, Schedule 131, delivery Norfolk.

Cars.—Pennsylvania Equipment Co., Philadelphia, Pa.—Combination passenger and baggage coach and two passenger coaches.

Cars.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on 3 all-steel hopper cars, Schedule 114, delivery Washington; and six 30,000-lbs-capacity flat cars, Schedule 106, delivery Norfolk.

Cars.—Pennsylvania Equipment Co., Philadelphia, Pa.—2000 to 3000 flat cars; 20, 25 or 30 tons capacity; second-hand.

Cement, Lime, etc.—J. W. Thornton, Dunn, N. C.—Prices on I-beams, steel posts, cement and lime.

Coal.—Compania de Importacion, No. 2 Langreo, Gijon, Spain.—Data, prices, discounts, terms, etc., on coal.

Compressor (Oxygen).—Ceco, care of Manufacturers Record, Baltimore, Md.—Prices on new or second-hand oxygen compressor.

Cotton Machinery.—F. D. Spencer, 1814 Winthrop Ave., Charlotte, N. C.—Data and prices on machinery to manufacture absorbent cotton and gauze.

Crackers (Nuts).—Benito Lloveras, 502 Liverpool & London & Globe Bldg., New Orleans, La.—Data and prices on machine to crack cohune (or palm) nuts, and separate the kernals whole and unscratched.

Crane (Locomotive).—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—15-20-ton 8-wheel locomotive crane.

Cranes.—Geo. D. Bouton, 701 Drexel Bldg., Philadelphia, Pa.—25-ton traveling crane, about 48 ft. 6 in. span; 10-ton pneumatic jib crane; 10-ton locomotive crane. Describe, state prices, and where can be inspected.

Crusher.—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—Large jaw crusher, about 24x48.

Dredging.—Bureau Yards and Docks, Navy Dept., Washington, D. C.—Bids until Oct. 7 for dredging in Cooper River, S. C., from Charleston Harbor to navy yard. Plans and specifications on application to bureau or to commandant of navy yard, Charleston, S. C.

Electric Fixtures.—A. F. Guirkin, 1302 Hillsboro St., Raleigh, N. C.—Prices on electric fixtures for five 6 to 9-room residences.

Electric-light Plant.—See Water-works and Electric-light Plant.—Board Public Works, O. M. Tillis, Chrmn., Havana, Fla.

Electrical Machinery.—See Engine (Steam).—Trustees Public Affairs, Geo. A. Petrie, Clk., Celina, O.

Elevator.—See Building Materials.—H. D. McCoy.

Engine (Steam).—Trustees Public Affairs, Geo. A. Petrie, Clk., Celina, O.—Bids until Sept. 26 to furnish and install 300 H. P. capacity steam engine, at 100 lb steam pressure, speed about 200 R. P. M., with not exceeding 2 lb. back pressure; bids to include all appurtenances; wants alternate bids on 300 H. P. steam engine complete, direct connected to 200 K. W., 2-phase, 60 cycle, 2300 alternator; specifications on file; and information supplied on application; Edgar B. Kay, Consit. Engr., 305 Colonial Bldg., Winchester, Ky.

Excavator.—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—Slack line cable excavator, about 1-yd. bucket.

Feed Water Heater.—Hackley Morrison, P. O. Box 120, Richmond, Va.—150 or 200 H. P. closed type feed water heater, National, Berryman or similar design.

Flooring.—A. F. Guirkin, 1302 Hillsboro St., Raleigh, N. C.—Prices on oak flooring for five dwellings.

Hammers (Steam, Pile).—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—No. 3 Vulcan steam pile hammer.

Handles.—Rainbow Manufacturing Co., 511 Cleburn Ave., W. Helena, Ark.—Addresses of manufacturers of duster handles.

Hardware, etc.—W. C. Sanders, Box 234, Swainsboro, Ga.—Catalogues and prices on office equipment, show cases, heaters, furniture (office), auto supplies and a light line of hardware such as would cost $2000 or $3000.

Heaters.—See Hardware, etc.—W. C. Sanders.

Heating.—A. F. Guirkin, 1302 Hillsboro St., Raleigh, N. C.—Prices on boilers and radiators for five dwellings.

Heating.—See Building Materials.—H. D. McCoy.

Iron and Steel Work.—See Building Materials.—H. D. McCoy.

Locomotives.—Pennsylvania Equipment Co., Philadelphia, Pa.—25 to 30 locomotives, Pacific type or similar; second-hand.

Locomotive.—Ralph R. Lewis Co., 538 Commercial Trust Bldg., Philadelphia, Pa.—24-in. gauge 4-wheel saddle-tank locomotive.

Lumber.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on 42,000 ft. cypress for boat building, Schedule 125, delivery Brooklyn, Charleston; also bids on following, Schedule 124: Port Orford cedar, delivery Brooklyn, Puget Sound; 20,000 ft. cypress or cedar, delivery Philadelphia; 12,000 ft. redwood, delivery Charleston.

Machine Tools, etc.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on following: Schedule 130, 30-in. plain radial drill; 16-in. high-speed, sensitive drill; 2-wheel emery grinder; one each, surface and portable drill grinder; 3 motor-driven, screw cutting lathes; universal milling machine; and 24-in. extension base, tool room shaper, all delivery Brooklyn; Schedule 109, 5 portable radial drills, delivery Newport; Schedule 112, two 6-ft., wall, radial drills, delivery Puget Sound; Schedule 115, two 36-in. tool grinders, delivery Philadelphia.

Metals.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on 18,000 lbs. regulus of antimony, Schedule 121, delivery Brooklyn; 9800 lbs. cold rolled sheet copper, Schedule 118, delivery Philadelphia; 1700 lbs. bar rolled monel metal, Schedule 121, delivery Boston; 17,500 lbs. boiler plate steel, and 9000 lbs. common steel shapes, Schedule 111, delivery Brooklyn; 3160 lbs. condenser tube sheets (4 sheets), Schedule 112, delivery Mare Island.

Mining Machinery, etc.—Compania de Importacion, No. 2 Langreo, Gijon, Spain.—Data, prices, discounts, terms, etc., on coal-mining machinery, miners' safety lamps, lubricating oils, automobiles, and typewriting machines.

Oils (Lubricating).—See Mining Machinery, etc.—Compania de Importacion.

Office Furniture and Equipment.—See Hardware, etc.—W. C. Sanders.

Paper Cup Machinery.—Star Paper Dish Co., 25th and Venable Sts., Richmond, Va.—Machinery to manufacture paper drinking cups.

Paving.—Baltimore (Md.) Board of Awards, City Hall.—Bids until Sept. 20 to grade and pave with cement-concrete various alleys; specifications and proposal sheets on application to R. M. Cooksey, Highways Engr.

Paving.—City of Mount Pleasant, Tex., J. F. Wilkerson, Mayor.—Will open bids Sept. 18 on 8500 sq. yds. paving, 10 catch-basins, 2500 cu. yds. excavation and 2000 lin. ft. sewer; H. S. Wilder, Engr., Mt. Pleasant.

Paving, etc.—City of Gadsden, Ala.—Bids until Sept. 18 to construct 2200 sq. yds. sidewalks and curbs and gutters; plans and specifications on file with Ernest Smith, City Engr.

Paving.—City of St. Louis, Mo., Room 315 New City Hall.—Bids until Sept. 22 to reconstruct Locust St. from Jefferson to Theresa Ave.; information from office of Prest., Room 326 New City Hall.

Paving.—W. H. McCorkle, Commr. Dept. of Public Works, Lexington, Ky.—Bids to construct concrete sidewalks, 4 ft. wide, on both sides of Columbia Ave. from Woodland to Locust Ave.; plans and profiles on file with City Engr.; bids opened Sept. 11.

Paving.—City of High Point, N. C.—Bids until Sept. 28 on 40,000 sq. yds. and alternate bids on 100,000 sq. yds. paving; sheet asphalt, bituminous concrete, brick and durax block considered; plans and specifications at office Arthur Lyon, City Mgr., and of Anderson & Christie, Consult. Engrs., Charlotte, N. C.

Paving.—Frank Good, City Clerk, Parkersburg, W. Va.—Bids until Sept. 20 to construct 1516 sq. yds. vitrified brick paving on concrete base with cement filler and 313 sq. yds. one-course cement paving; also excavation, concrete curbing, etc., in connection; plans and specifications from City Engr.

Paving.—Board of Awards, John Hubert, Prest., Baltimore, Md.—Bids in duplicate, care of City Register, City Hall, until Sept. 27, to grade, curb and pave with sheet asphalt, vitrified block and wood block paving and granite block repaving, all on concrete base, the following: Contract 140, Lexington St., from Eutaw to Liberty, and Etting St., from Hoffman to Mosher, 7650 sq. yds. sheet asphalt, 665 sq. yds. vitrified block, 310 sq. yds. wood block; Contract 141, Gay St., from Baltimore St. to North Ave., 25,950 sq yds. sheet asphalt, 2800 sq. yds. vitrified block and 12,250 sq. yds. granite block repaving; plans and profiles on file office of Consit. Engr.; specifications, etc., obtainable from office of Paving Com., R. Keith Compton, Chrmn. and Consit. Engr., 214 Lexington St., Baltimore.

Pipe.—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on terra-cotta sewer pipe, galvanized steel pipe, and 20 pieces acid-proof stoneware pipe, 8-in. diam. by 10 ft. long, Schedule 103, delivery Washington; also black steel pipe, Schedule 111, delivery Brooklyn.

Plumbing.—See Building Materials.—H. D. McCoy.

Road and Bridge Construction.—State Roads Com., Frank H. Zouck, Chrmn., 601 Garrett Bldg., Baltimore Md.—Bids until Sept. 26 to construct 5 mi. road from end of Showell Rd. north toward Selbyville, concrete or macadam, oil bound, Contract No. Wo-13, Worcester County; also 90-ft. reinforced concrete arch over Western Run along York Rd., Contract No. B-21-Br.; specifications and plans obtainable from Com. for $1.

Road Construction.—Grenada County Supvrs., M. E. Powell, Clerk, Grenada, Miss. Bids until Oct. 2 to construct 50 mi. sand-clay roads; plans and specifications by Snowden & Hauser, Civil Engrs., Jackson, Miss., on file with Chancery Clerk; bids received on work in sections and as whole; amount available for total road construction, $100,000.

Road Construction.—Coosa County, Lofton Thomas, Judge of Probate, Rockford, Ala.—Bids until Sept. 19 to construct 4 mi. Clisby Rd.; 5 mi. Turnpike Rd.; 3 mi. Smith's Ferry Rd.; 8 mi. from Goodwater to Talladega county line by way of Mount Olive; 3 mi. from Soccopotoy to Tallapoosa county line by way of Kellyton; specifications and information from Lofton Thomas, Judge of Probate, Rockford, or W. P. Moon, County Engr., Goodwater, Ala.

Sewer Construction.—City of Tulsa, Okla., H. H. Wyss, City Engr.—Bids to construct sanitary sewer, including laterals, connections, etc., in Dist. No. 24; plans, etc., on file with H. H. Wyss, City Engr.; bids opened Sept. 11.

Steel Beams.—See Cement, Lime, etc.—J. W. Thornton.

Steel Posts.—See Cement, Lime, etc.—J. W. Thornton.

Sprinkler System.—See Building Materials.—H. D. McCoy.

Tanks (Powder and Cartridge).—Navy Dept., Bureau Supplies and Accounts, Washington, D. C.—Bids on 145,000 powder and cartridge tanks, Schedule 107, delivery f. o. b. Works.

Tanks (Steel).—John G. Duncan Co., 308 W. Jackson Ave., Knoxville, Tenn.—Dealers price on second-hand 1000, 2000, 3000, 4000 and 5000 gal. steel tanks.

Typewriters.—See Mining Machinery.—Compania de Importacion.

Water-works and Electric-light Plant.—Board Public Works, O. M. Tillis, Chrmn., Havana, Fla.—Bids until Oct. 23 to construct water-works and electric-light plant ($20,000 bonds available); plans and specifications on file.

Wireworking Machinery, etc.—Agustin Caze, 202 Calle Valencia, Barcelona, Spain.—Data, prices, discounts, terms, etc., on wireworking machinery; round plates, 5 and 6 millimeters thick, in pieces 60 centimeters in diam., and weighing about 40 to 45 kilos, quality known as "acid" and "basic;" steel wire, extra strong for making cables and springs; ductile steel bars for corsets or "carrera" or "course" of a chain; jute bags (Bombay and Calcutta type) of all kinds, for chemicals, cement, sugar, meal, etc.

Wiring.—See Building Materials.—H. D. McCoy.

RAILROAD CONSTRUCTION

RAILWAYS

Fla., Bunnell.—The Dowling-Shands Lumber Co. is reported standard gauging the Dupont Ry. from Orange Hammock to Haw Creek Farms and Dupont and an extension will be built to a dock at St. Johns Park, also a connection 4 mi. long from Bunnell to the present railway.

Md., Baltimore.—Concerning its recent acquisition of more land at Locust Point, Baltimore, the Baltimore & Ohio Railroad Co. says that there is no decision to enlarge its yards at present.

S. C., Greenville.—W. J. Jones, of Lexington, Ky., and Russell N. Edwards of Indianapolis, Ind., civil engineers, are reported making investigations at Greenville concerning the proposition to build an electric railway from there to Asheville, N. C.

S. C., Rock Hill.—Survey is reported made by W. M. Moncure, Hamlet, and corps of engineers for construction of railroad from Rock Hill to Spencer, S. C., about 12 mi. John T. Roddey is the promoter.

Va., Richmond.—Newport News Short Line, Richmond, will, it is reported, soon receive bids for construction of railway from Newport News to Washington, D. C., about 210 miles, with branch 50 miles long. F. S. Gannon, 2 Rector St., New York, is Prest., and C. M. Ward, Virginia Railway and Power Bldg., Richmond, Gen. Mgr.

Va., Spotsylvania.—Contract is reported let to Cowherd & Cowherd of Columbia for construction of railway in Spotsylvania County from Holloday mine to Sulphur Mine, near Mineral, Va., about 12 miles.

W. Va., Charleston.—The Kanawha & Michigan Rwy. Co. says there are no plans at present for the extension of the Kanawha & West Virginia Rwy., which it recently acquired.

STREET RAILWAYS

N. C., Charlotte.—Charlotte Electric Railway Co. is preparing to build an extension to the Mecklenburg Country Club. J. R. Cherry is Mgr.

New Spark Plug Design.

Long distance spark plugs for gasoline motors, manufactured by the Long Distance Spark Plug Company, Birmingham, Ala., are illustrated and described in a folder recently issued. In this folder the company explains its special introductory proposition and gives an outline of the advantages of the design employed and a short description of the construction features of the plug.

INDUSTRIAL NEWS OF INTEREST

Opens Engineering Office.

Howard M. Gassman, formerly chief electrical engineer of the Tennessee Coal, Iron & Railroad Co., Birmingham, has entered the consulting engineering field and has established offices at 720-21 Brown-Marx Bldg., Birmingham, Ala. He will specialize in mechanical and electrical engineering as applied to mining and manufacturing plants.

Wants to Represent Manufacturers in Latin America.

Wm. Anthony Burr, industrial engineer, Box 84, Gillham, Ark., writes that on October 15th he will start on a trip through Central and South America for the purpose of representing such manufacturers as may desire to introduce their products into those countries. He states that he has had fifteen years' experience as an industrial engineer in Latin America, speaks the language fluently and has a large and influential acquaintanceship with the business men of the Southern Republics.

Machine and Foundry Equipment for Sale.

J. E. Conant & Co., auctioneers, Lowell, Mass., will sell to the highest bidder, in lots to suit purchasers, all the machinery, including direct motor-driven heavy machine tools, punches, shears, etc.; all the mechanical equipment, including electric-power units; air-compressor units; contents of pattern shop; contents of blacksmith shop; foundry equipment; extensive derrick equipment, and other machinery and equipment of the G. W. & F. Smith Iron Co., Boston, Mass. The sale will be held on the premises September 19 and 20. Full information may be obtained from the auctioneers.

Enameled Brick for Chemical Plants.

General use of enameled brick in the construction of a variety of chemical industries is pointed out by the American Enameled Brick & Tile Company, 52 Vanderbilt Avenue, New York, in the following list of companies which employed its acid proof enameled brick in building their plants: Tennessee Coal, Iron & Railroad Co., 40,000 bricks in by-product building at Fairfield, Ala.; La Belle Iron Works, Follonsbee, W. Va., 10,000 bricks for by-product building; American Thread Co., Spray, N. C., 12,000 bricks in dye bins; Otto Coking Co., 22,000 bricks in benzol plant at Youngstown, O., and 30,000 bricks in by-product building at Lackawanna, N. Y.; Crucible Steel Co., Harrison, N. J., 20,000 bricks; Bethlehem Steel Co., South Bethlehem, Pa., 21,000 bricks; Naumkeg Steam Co., Salem, Mass., 40,000 bricks in weave shed; Standard Oil Co., 20,000 bricks in laboratory building at Brooklyn, N. Y., and Henderson & Irvin, Norwalk, Conn., 25,000 enameled bricks in dye bins.

New Commissions of an Atlanta Landscape Architect.

Indicative of the number of fine houses that are being built in the South at the present time and care that is being exercised in planning the grounds so as to provide a proper setting for the buildings and appropriate arrangement of driveways, walks and other features, to be in keeping with the magnificence of the structures, are the recent commissions received by E. Burton Cooke, landscape architect, of Atlanta. Mr. Cooke has made a life study of development of home grounds, public parks, cemeteries and residential real estate subdivisions. His experience extends through a period of fifteen years, most of which has been spent in the South, thus familiarizing him with Southern conditions and the flora of the South Atlantic and Gulf States. For five years of this time he was connected with the landscape department of the Vanderbilt estate in Western North Carolina. The following are some of the larger residential commissions which have been awarded Mr. Cooke recently: Mrs. J. H. Carpenter, Nashville, Tenn.; G. A. Goding, Nashville; J. Wade Tucker, Kissimmee, Fla.; Lucian Lamar Knight, Atlanta; Wade H. Davis, Atlanta; J. Epps Brown, Atlanta; Henry S. Jackson, Atlanta, and Benjamin C. Yancy, Rome, Ga.

Enlarges Plant for Producing American Clay Superior to German Product.

Chevalier & Tully, of Baltimore, have just completed a plant, in which specially designed machinery has been installed for the production of what will be known to the trade as "K-10" clay. This material will replace the famous Klingenberg clay, in the manufacture of graphite crucibles, lead pencils, carbon brushes, emery wheels, and other products wherein a very plastic and highly refractory clay is required. Plans are being prepared by Chevalier & Tully for a plant double the size of the present one which they hope to have completed November 1st and thus enable them to supply the heavy demand that has been made upon them for "K-10". The process which is a complex and expensive one has been worked out by the Kraus Research Laboratories, Inc., 100 39th Street, Brooklyn, N. Y., and physical tests are said to have proven the material to be slightly superior to the German product. The materials used in the production of "K-10" being in process for 14 days which limits the production accordingly. The process consists of extracting the necessary constituents from clays, etc., and combining them in such a manner as to produce a fine grain, highly plastic refractory mass, having an excellent (water) solubility and melting point. It possesses unusual strength upon air-drying and has a very high "bonding" power.

FINANCIAL NEWS

FINANCIAL CORPORATIONS

Ark., Prescott.—First State Bank, capital $25,000, is inceptd. and chartered, succeeding the Nevada County Bank. C. A. Smith, Texarkana, Prest.; E. M. Sharp, Cash., and W. B. Waller, V.-P., both of Prescott. Business began Aug. 28.

Ky., Maysville.—The Standard and First National banks of Maysville have merged under the name of the First Standard Bank & Trust Co., capital $175,000. James N. Kehoe, Prest.; Thomas A. Keith, V.-P.; J. Banks Durrett, Cashier and James E. Threlkeld, Asst. Cashier.

Ky., Trenton.—Planters Bank of Trenton is approved. This is a consolidation of the Planters Bank of Trenton and the Planters Trust Company. Capital $25,000.

Miss., Chalybeate (R. F. D. Walnut).—Chalybeate Bank, capital $10,000, is being organized by W. E. Clemmer, J. Finch Ray and J. S. Horton. It is stated that Mr. R. L. Clemmer will be Prest. and W. E. Clemmer, Cash.

N. C., Wilmington.—Community Savings & Loan Co., chartered, capital $25,000, has elected the following officers: A. M. Hall, Prest.; C. W. Polvogt and W. I. Baxter, V.-Ps.; W. G. James, Secy.-Treas. Business is to begin soon.

S. C., Camden. — Camden Building and Loan Assn. is commissioned; capital $200,000; petitioners, L. A. Kirkland, E. N. McDowell, J. S. Lindsay, J. P. Lewis and J. H. Clyburn.

Tex., Dallas.—Dickinson Mortgage Co., chartered; capital $50,000. Incptrs.: O. K. Dickinson, Henry T. Abbott and Monta R. Ferguson.

Va., Hampton.—Hampton Savings & Loan Co., Inc., capital $5000 to $25,000. Louis Heffelfinger, Prest.; L. M. VonSchilling, Secy.-Treas.

NEW SECURITIES

Ala., Eufaula—(School).—Election to vote on $15,000 school bonds will be held Sept. 18. Address The Mayor.

Ala., Montgomery—(Bridge).—Election is to be held in Montgomery County in 1917 to vote on $50,000 bonds for construction of bridge over Tallapoosa River. Address County Commrs.

Ala., Montgomery—(City Hall, Sewer, School).—Election is to be held Oct. 17 to vote on $250,000 city hall, $25,000 sewer and $25,000 school bonds. W. T. Robertson is Mayor.

Ark., Walnut Ridge—(Drainage).—$25,000 5½ per cent. 5-15-year $100 and $500 denomination Lower Running Water Drainage Dist. bonds have been purchased by Whittaker & Co., St. Louis, Mo., at $101.30.

Fla., Bradentown.—Bids will be received until 2 P. M. Sept. 29, for $35,000 5 per cent. $500 denomination 20-30-year bonds. L. D. Simmons, Mayor and E. L. Hine, City Clk. *Further particulars will be found in the advertising columns.*

Fla., Ft. Myers—(Road and Bridge).—$164,000 bonds Special Road and Bridge Dist. No. 2, Lee County, have been purchased at par, accrued interest and $1000 premium by G. B. Sawyer & Co., Jacksonville.

Fla., Havana—(Water, Light).—Bids will be received until Oct. 23, inclusive, for $20,000 5 per cent. bonds, maturing 1921 to 1945 inclusive. O. M. Tillis is Chrmn. Bd. of Trustees. *Further particulars will be found in the advertising columns.*

Fla., Macclenny — (Highway). — Election will probably be held Oct. 15 to vote on $60,000 Baker County bonds. Address County Commrs.

Fla., Ormond — (Boulevard). — Ormond Boulevard bonds are voted. Address The Mayor.

Fla., Panama City—(Road).—The $375,000 city and Bay County bonds to be voted on Sept. 19 are 5 per cents. Denomination $1000. Dated Jan. 1, 1917; maturity Jan. 1, 1924 to Jan. 1, 1938 inclusive. T. B. Young is Chrmn. Bd. County Commrs.

Fla., Sarasota—(Pier, Park).—$18,000 municipal pier bonds are voted. Park bonds defeated. Harry L. Higel is Mayor and Prest. of the Council.

Fla., St. Cloud—(Water-works, Sewer).—$115,000 water and sewer bonds are voted. Address The Mayor.

Ga., Alma—(Improvements).—Election is to be held in Bacon County Nov. 7 to vote on bonds, amount not to exceed $100,000. Address County Commrs.

Ga., Damascus—(Light).—Sept. 15 election to vote on $10,000 electric-light plant and water-works system bonds. J. D. Haddock is Mayor.

Ga., Lithonia—(Water-works, Sewerage). Election is to be held Oct. 12 to vote on $35,000 5 per cent. 30-year bonds. Address The Mayor.

Ga., Newborn—(Light).—$3000 electric-light bonds are voted. L. P. Dyke is City Clerk.

La., Alexandria — (Improvement). — Bids will be received until 7.30 P. M. Sept. 25 for $30,000 5 per cent. bonds, dated Aug. 1, 1916, and maturing Aug. 1, 1927, to Aug. 1, 1946; denomination $500. W. W. Whittington, Jr., is Mayor. *Further particulars will be found in the advertising columns.*

La., Many—(Road).—Bids will be received until noon Oct. 2 by J. M. Abington, Clk. Road Dist., Sabine Parish, for $30,000 5 per cent. 1-20-year bonds.

Md., Cumberland—(School).—$75,000 4½ per cent. Allegany County bonds have been purchased jointly by Nelson, Cook & Co., Baker, Watts & Co., and Townsend Scott & Son, Baltimore.

Miss., Canton—(Road).—Bids will be received Oct. 3 for $75,000 10-25-year $500 denomination bonds Supvrs.' Dist. No. 1, Madison County; interest not to exceed 6 per cent. D. C. McCool is Clerk Board of Supervisors Madison County. *Further particulars will be found in the advertising columns.*

Miss., Canton—(School).—Bids will be received Oct. 3 for $50,000 11-25-year $500 denomination bonds Supvrs.' Dist. No. 3, Madison County, dated Nov. 1, 1916. D. C. McCool is Clerk Board of Supvrs. *Further particulars will be found in the advertising columns.*

Miss., Coffeeville—(Road).—Board of Supervisors Yalobusha County has voted $100,000 bonds.

Miss., Crystal Springs—(Sewer).—Election is to be held in thirty days to vote on bonds. Address The Mayor.

Miss., Ellisville—(Charity Hospital.)—$20,000 Jones County bonds are voted. H. B. Graves is Clerk Chancery Court, Jones County.

Miss., Gulfport—(Seawall).—All bids received Sept. 5 for $200,000 seawall bonds were rejected. The bonds will probably be sold at private sale. Geo. W. Foote is Mayor and J. W. Bradley, Clk.

Miss., Hazlehurst—(Road, Bridge).—$50,000 5 per cent. Copiah County bonds have been purchased at par, accrued interest and $1965 premium by Continental & Commercial Trust & Savings Bank, Chicago, Ill.

Mo., Independence—(School).—$75,000 4½ per cent. 5-20-year $500 and $100 denomination bonds have been purchased at $76,100 by E. T. Richard, McAlester, Okla.

Mo., Marble Hill—(Road).—Election will be held in the spring of 1917 in this (Bollinger) county on $160,000 of road bonds. Address Secy. County Highway Board.

Miss., Meridian—(School).—Election is to be held Sept. 30 to vote on bonds for Kewanee Consolidated School Dist., Lauderdale County. Address Board of Trustees.

N. C., Beaufort—(Water, Sewer, Street).—Bids will be received until 3 P. M. Sept. 29 for $100,000 5 per cent. bonds. Chas. H. Bushall is City Clerk. *Further particulars will be found in the advertising columns.*

N. C., Durham—(Courthouse).—Arrangements are being made to issue $75,000 4¼ per cent. $1000 denomination, Durham County bonds, dated Oct. 1, 1916. G. W. Flowers is Chrmn. Bd. County Commrs.

N. C., Morganton—(Road).—$50,000 5 per cent. 30-year Icard Township, Burke County, bonds have been purchased by W. L. Slayton & Co., Toledo, O.

N. C., Morganton—(Road, Bridge).— lection is to be held in Quaker Meadows Township, Burke County, Oct. 14 to vote on $30,000 5 per cent. 30-year road and bridge bonds. J. M. Brinkley is Chrmn. Bd. of Commrs. and J. B. Holloway, Secy.

N. C., Morganton—(Road).—Election to be held in Lovelady Township, Burke County, Sept. 30, on $50,000 bonds. J. B. Holloman is Chrmn County Commrs.

N. C., Morganton—(Road).—Election is to be held Sept. 30 to vote on $20,000 5 per cent. 30-year Silver Creek Township, Burke County bonds. J. M. Brinkley is Chrmn. Bd. of County Commrs. and J. B. Holloway, Secy.

N. C., Morganton—(Road, Bridge).—Elec- be held in Upper Fork Township, Burke County, Sept. 16 to vote on $10,000 5 per cent. 30-year bonds. J. M. Brinkley is Chrmn. Bd. County Commrs. and J. B. Holloway, Secy.

N. C., Rockingham—(Street).—$15,000 5 per cent. 30-year bonds have been purchased by W. L. Slayton & Co., Toledo, O.

Okla., Bartlesville—(Road).—Election will probably be held in Washington County in the fall to vote on bonds. Address County Commrs.

Okla., Bartlesville—(Road).—Election will probably be held in the fall to vote on bonds. Address County Commrs.

Okla., Blackwell — (Light and Water). — Election is to be called to vote on $35,000 light and water bonds. Address The Mayor.

Okla., Commerce—(Sewer).—City contemplates holding election to vote on bonds for sewers to cost approximately $30,000. Address The Mayor.

Okla., Cordell—(Sewer).—$25,000 6 per cent. 25-year bonds have been sold. R. L. Harvey is Mayor.

Okla., Miami — (Light, Water). — $25,000 bonds are reported sold. Address The Mayor.

Okla., Sand Springs — (Sewer).—$30,000 bonds are voted. Address The Mayor.

S. C., Chester—(Paving).—Plans are being made to issue bonds. Nothing definite as yet. Z. V. Davidson is Mayor. (Recently noted.)

S. C., Greenville—(Street).—Election is to be held Sept. 26 to vote on $65,000 5 per cent. 30-year bonds. C. S. Webb is Mayor and G. Frank League, City Clk. and Treas.

S. C., Greenville—(Sewer, Street, City Hospital).—Election is to be called to vote on $25,000 sewer extension and $60,000 city hospital bonds. C. S. Webb is Mayor and G. Frank League City Clerk and Treas.

Tenn., Knoxville (Water-works).—Election to vote on $225,000 5 per cent bonds is postponed from Sept. 30 to Oct. 24. John E. McMilan is Mayor.

Tenn., Lenoir City—(Street).—Bids will be received until 5 P. M. Sept. 21 for $18,500 6 per cent. $500 denomination 1-5-year bonds, dated Sept. 1, 1916. H. N. Curd is Mayor and W. U. Shipley Recorder.

Tenn., Lewisburg — (Road).—Special election is to be held Oct. 7 to vote on $103,000 Fort Spring Dist., Greenbrier County, bonds. Address County Commrs.

Tenn., Murfreesboro—(School).—Date for holding election to vote on $75,000 high school bonds will be held Sept. 18 instead of Sept. 25 as recently reported. G. B. Giltner is Mayor.

Tenn., Murfreesboro — (Street). — Bids received noon Sept. 14, it is reported, by G. B. Giltner, Mayor, for $15,000 5 per cent. 10-year bonds and $3000 6 per cent. 1-5-year bonds.

Tenn., Newport—(School).—Bids will be received until 1 P. M. Sept. 30 for $30,000 5 per cent. $1000 denomination Cocke County bonds; denomination $1000. J. N. Jones is Chrmn. County Court.

Tex., Beaumont — (Wharf, Quay Wall, Water).—$230,000 wharf and quay wall and $100,000 water-works 5 per cent. bonds are voted. J. G. Sutton is City Secy.

Tex., Boston—(Road).—$25,000 Redwater

Precinct, Bowie County, bonds are voted. Address.

Tex., Childress—(Warrants).—$33,000 6 per cent. 2-25-year warrants have been purchased by J. L. Arlitt, Austin, Tex.

Tex., Denton—(School).—$20,000 5 per cent. 10-40-year bonds have been purchased at $331 premium by William R. Compton Investment Co., St. Louis.

Tex., Fort Worth—(School).—Sept. 30 election is to be held to vote on $20,000 bonds. E. E. Edwards is Asst. Supt. of Schools.

CLASSIFIED OPPORTUNITIES

RECEIVED TOO LATE FOR CLASSIFICATION

ZINC LAND

"ARKANSAS ZINC PROSPECT."—Young mining engineer has zinc carbonate prospect located three miles from railroad. Lease is good for five years yet at 10 per cent. royalty. At present $1000 worth of ore on dump. Mine is in prospect stage and paying expenses, working two men. A moderate outlay spent judiciously can make a paying mine. Will sell whole interest, but prefer holding an interest and operating the mine. What can you offer? Time is more than essential. Box 53, St. Joe, Arkansas.

TIMBER LAND

RARE OPPORTUNITY IN FLORIDA VIRGIN TIMBER.—21,800 acres long-leaf yellow pine in one compact body within 1 mile of railroad, 50 miles from Tampa, estimated by sections by a reputable timber expert estimater to cut 60,000,000 feet of lumber (good heart) and 60 crops of turpentine boxes. Direct from owner in fee-simple, $5.50 per acre cash or $6 per acre one-half cash, balance 1, 2 and 3 years. This is undoubtedly one of the biggest bargains ever offered. For full particulars write Wm. Nussbaum, Jacksonville, Fla.

FARM AND TIMBER LANDS

STOCK FARM AND TIMBER.
1253 acres; about half is well timbered, estimated to cut four million feet original-growth oak, forest pine and second-growth pine, about one-third of each; several hundred acres farming and grazing land; large mansion-house; 5 miles from station; owner leaving State. Write for price and full particulars of this and other timber and farm properties. Venable & Ford, Lynchburg, Va.

FRUIT, FARM AND TRUCK LANDS

ARKANSAS

600-ACRE PLANTATION in garden spot of East Ark., all level alluvial land, producing as high as $100 per acre this year in cotton; fully equipped with labor, tenant-houses; rice well, pump, etc.; $45,000. F. D. Pierson, 5175 Cates Ave., St. Louis, Mo.

FLORIDA

FOR INVESTMENT, SPECULATION OR COLONIZATION—1620 acres ideal citrus and natal hay land. High and rolling; a number of clear, deep lakes on tract. Boating, bathing and fishing unsurpassed. Adjacent lands being retailed at $75 per acre. Price $10 per acre.
320 acres within mile of Polk County's famous asphalt road system. Well timbered with yellow pine. Combination land, citrus, truck and general farm land, and ideal stock farm location in sight of large lake. Timber now worth 50% of price asked. $10 per acre. Address Roger B. Lyle, Bartow, Fla.

GEORGIA

FOR SALE—My plantation in Wilkes county, Ga., consisting of 776 acres of well improved, level land. Fifteen-horse farm in cultivation. I will sell this place for $20 per acre and will lease it for 5 years for 10,000 pounds of cotton per year. Will give my rent note for the 20 bales per year. Reason for selling made known to the inquirer. J. W. Binns, 48 Gordon St., Atlanta, Ga.

BUSINESS OPPORTUNITIES

VALUABLE PROPERTIES FOR SALE.
To settle an estate, the following properties will be sold privately at much less than their real worth:
1.—Timber lands, requiring cash capital of $250,000, and of which the cleared land will be easily salable for the whole cost; cypress, oak, poplar, pine. Other timber adjoining can be bought.
2.—Big old plantation, fine condition in every way, ten thousand acres, ideal for rich man's estate or for colonization. Requires $200,000.
3.—Home in best bird-hunting section of the South, comfortable house, big grove and orchard, $3500. Ideal for health seeker or hunters.
4.—Sawmill and timber, ready for business, $60,000.
5.—Clubhouse and 400 acres, with 60-acre fishpond, near Pinehurst, for $14,000. This property in perfect condition, and cost $22,000 seven years ago. 500 acres adjoining also for sale cheap.
Full particulars will be furnished on request from responsible parties, but no attention will be given to inquiries unless they give evidence they can finance the particular property desired. We prefer to correspond directly with prospective purchaser, or will pay liberally for anyone putting us in correspondence with a purchaser.
Address No. 2044, care Manufacturer's Record, Balto., Md.

FOR SALE—700 acres on railroad adjoining town of 5000; textile mill site and town development or subdivision proposition; electric power. Address Doak Aydelott, Tullahoma, Tenn.

INDUSTRIES WANTED

ELECTRIC PLANT

WANTED—Electric light and power plant; excellent water-power available. City just starting development campaign. Address Chamber of Commerce, Chatsworth, Ga.

AGENCIES WANTED

SELLING AGENCY WANTED.—We want additional live lines to sell in the city of Atlanta and vicinity or to cover all Southern States. We have a selling organization with customers all over the South, and are prepared to show results on additional lines. We are not particular what they are so long as they are live and will respond to active selling and advertising treatment. Address, with full particulars, Sumter Telephone Supply Co., 32-34 Fairlie street, Atlanta, Georgia.

SITUATION WANTED

SALES MANAGER OR SALESMAN desires to locate with progressive manufacturer. Wide experience as special representative. Have successful record as producer. Seeking advancement over present position, where ability, etc., counts. Address No. 2045, care Manufacturers Record.

(CLASSIFIED OPPORTUNITIES CONTINUED ON PAGES 168 AND 169.)

Tex., McKinney—(Levee).—$42,000 bonds Collin County Levee Improvement Dist. No. 1 have been voted. Address Bd. of Commrs.

Va., Alta Vista—(Water, Street).—$35,000 5 per cent. 30-year $100 and $500 denomination bonds are voted and $16,000 of the amount will soon be placed on the market. W. C. Bess is Mayor.

Va., Covington—(Road).—Reported that $100,000 Covington Dist., Alleghany County, bonds have been voted by Board of Supvrs., and bids for same will soon be asked.

Va., Newport News—(Street).—Election will probably be called within sixty days to vote on $50,000 bonds. Address The Mayor.

W. Va., Charleston—(Road).—$90,000 5 per cent. $1000 denomination Loudon Dist., Kanawha County, bonds are voted. L. C. Massey is Clerk County Court.

W. Va., Harrisville—(Road).—$240,000 Clay Dist., Ritchie County bonds, have been purchased by Otis & Co., Cleveland.

W. Va., Logan—(Road).—Bids will be received until 1 P. M. Sept. 16 by Brice McDonald, Prest., Logan County Court, for $200,000 5 per cent. road bonds, dated May 20, 1916.

PROPOSALS
RECEIVED TOO LATE FOR CLASSIFICATION

Bids close September 29, 1916.

$100,000 5% Bonds

Beaufort, N. C.

The Town of Beaufort, North Carolina, offers for sale, at par and accrued interest, $100,000 of 5 per cent. semi-annual water-works-sewerage-street bonds. Bids will be opened at 3 P. M. o'clock, September 29, 1916. Each bid must be accompanied by duly certified bank draft or check in amount 2 per cent. of issue. Town reserves right to reject any or all bids.

Information in full on application to
CHAS. H. BUSHALL,
City Clerk.

Bids close October 3, 1916.

$75,000 Road Bonds

Canton, Miss.

Notice is hereby given that the Board of Supervisors of Madison County, Mississippi, at Canton, said State, will on the 3d day of October, 1916, at said city, receive sealed bids for the sale of $75,000 of Supervisors' District No. 1 Road Bonds, under authority of Chapter 149 of the Laws of Mississippi, 1910, as amended by Chapter 145 of the Laws of Mississippi, 1912, as amended by Chapter 176 of the Laws of Mississippi, 1914. Said bonds to be dated November 1, 1916, shall be numbered from 1 to 150 consecutively, to mature as follows: Nos. 1 to 140, both inclusive, shall mature ten bonds each year, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24 years after date, respectively, and bonds 141 to 150, both inclusive, shall mature 25 years after date. Said bonds to bear interest at a rate not greater than 6 per cent. per annum interest from date, payable semi-annually. Denominations of said bonds shall be $500 each. Principal and interest payable at Canton, Miss. Certified check for 5 per cent. of amount bid shall accompany each bid. Board reserves right to reject any and all bids. Bids must be unconditional. Transcript of record will be furnished for $5.

D. C. McCOOL, Clerk.

Bids close October 3, 1916.

50,000 Bonds

Canton, Miss.

Notice is hereby given that the Board of Supervisors of Madison County, Mississippi, will on the 3d day of October, 1916, at Canton, Miss., receive sealed bids for the sale of $50,000 of Supervisors' District No. 3 Bonds, under authority of Chapter 149, Laws of Mississippi, 1910, as amended by the Laws of Mississippi, 1912, 1914, 1916. Said bonds to be dated November 1, 1916, in denominations of $500, bearing interest from date at rate not to exceed 6 per cent. per annum, interest payable semi-annually, principal and interest payable at Canton, Miss. Numbered serially from 1 to 100, inclusive, maturing as follows: Bonds Nos. 1 to 84, both inclusive, shall mature serially six bonds each year 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24 years after date, respectively, and bonds Nos. 85 to 100, both inclusive, shall mature 25 years after date. Certified check for 5 per cent. amount bid shall accompany each bid. Board reserves the right to reject any and all bids. Bids must be unconditional. Transcript of record will be furnished for $5.

D. C. McCOOL, Clerk.

Bids close September 25, 1916.

$30,000 5% Bonds

Sealed bids will be received by the undersigned until 7.30 P. M. Monday, September 25, 1916, for thirty thousand ($30,000) dollars five per cent. public improvement bonds, sixth series, of the City of Alexandria, Louisiana, dated August 1, 1916, of denominations of five hundred ($500) dollars, each maturing as follows:

$500 on August 1 of each of the years 1917 to 1927.

$1000 on August 1 of each of the years 1928 to 1937.

$1500 on August 1 of each of the years 1938 to 1944.

$2000 on August 1 of each of the years 1945 and 1946.

Principal and semi-annual interest coupons payable at the City Treasurer's office, Alexandria, Louisiana, or the United States Mortgage & Trust Co., New York City. No bid for less than par and accrued interest will be received, and the right to reject any and all bids is reserved. Each bid must be accompanied by certified check upon an incorporated bank for one (1%) per cent. of the amount of bonds bid for. The bonds will be prepared under the supervision of the United States Mortgage & Trust Co., who will certify to the genuineness of the signatures of the city officials and seal impressed thereon. The legality of the issue will be examined by Messrs. Caldwell & Masslich of New York City, and the purchaser will receive, without charge, an approving opinion of said attorneys.

Financial statement of the City of Alexandria and other information desired will be furnished upon application to the undersigned.

W. W. WHITTINGTON, JR.,
Mayor of the City of Alexandria, La.

Bids close October 2, 1916.

Sand Clay Roads

Grenada Miss.

Notice is hereby given that sealed bids will be received by the Board of Supervisors of Grenada County, Mississippi, at the office of the Chancery Clerk of said county, at Grenada, Mississippi, until 2 o'clock P. M. October 2, 1916, for the construction of approximately fifty (50) miles of sand-clay roads, according to plans and specifications of Snowden & Hauser, Civil Engineers, Jackson, Mississippi, now on file in the office of said Chancery Clerk. Bids will be received on the work in sections and as a whole. Bid bond in the sum of ten per cent. of the bid shall accompany each and every proposal. The Board reserves the right to reject any and all bids. Amount available and in bank for total road construction, $100,000.

Done by order of the Board on this the 6th day of September, A. D., 1916.

M. E. POWELL,
Clerk of the Board of Supervisors,
Grenada County, Mississippi.

Bids close September 28, 1916.

Street Improvements

High Point, North Carolina.

Sealed proposals will be received for the materials and labor in connection with the improvement of certain streets of the City of High Point, N. C., by the Mayor and Board of Councilmen of said city until three (3) o'clock P. M. of Thursday, September 28, 1916, when they will be opened and publicly read.

The specifications cover sheet asphalt, bituminous concrete, brick and durax block, and in addition to the above proposals will be considered upon other types of pavements. Work contemplated will also include grading, furnishing, placing and construction granite curb; vitrified brick and concrete gutters; concrete curb and gutter; installation of storm drains, and the reconstruction of street-railway tracks.

Bids are asked upon approximately 40,000 square yards of pavement with alternative bids on approximately 100,000 square yards. The pavement will be constructed from one or more of the classes mentioned above as may be selected by the city, and the entire work will be awarded under one or more contracts, as the city may elect.

Plans and specifications may be examined at the office of the City Manager or at the offices of the Engineers. Specifications may be obtained by prospective bidders on or about September 18 by addressing the Consulting Engineers at Wilson, N. C., and making a deposit of $10, which deposit will be refunded upon the return of the specifications in good condition.

Each proposal must be accompanied by a certified check in the sum of five (5) per cent. of the amount bid, as evidence of good faith upon the part of the bidder.

The city reserves the right to reject any or all bids or accept any which may seem to it to be to the best interest of the City of High Point.

W. P. PICKETT, Mayor.
ARTHUR LYON, City Manager.
A. E. TAPLIN, Resident Engr.
ANDERSON & CHRISTIE, Inc.,
Consulting Engineers,
Charlotte, N. C.

Bids close Oct. 18, 1916.

Bridge, Draw Span and Causeway

Arcadia, Fla.

Sealed proposals on blank form furnished by the Board and addressed to the Board of County Commissioners of De Soto County, Fla., at Arcadia, Fla., will be received until 12 o'clock M. October 18, 1916, for furnishing material, equipment, labor and constructing in Charlotte Harbor Special Road and Bridge District of De Soto County, across Charlotte Harbor, between the towns of Charlotte Harbor and Punta Gorda, the following:

One reinforced concrete bridge approximately 4700 feet long, complete with draw span, having 50-foot clear opening, and 2100 lineal feet of causeway. Bridge to be monolithic beam and slab structure supported on concrete piles, and causeway to be hydraulic fill protected by reinforced concrete sheet piling.

Bids on alternate designs according to specifications will be accepted.

Each bid is to be accompanied by a certified check, made payable to the Chairman of the Board, for at least Two Thousand Dollars.

The right is reserved to reject any and all bids.

Plans and specifications can be seen at the office of the County Clerk at Arcadia or the Engineers at Bartow, Fla., and Punta Gorda, Fla., and specifications can be obtained by writing the Engineers at Box 384, Bartow, Fla.

L. W. WHITEHURST,
Chairman.
A. L. DURRANCE,
Clerk.
H. S. JAUDON ENGINEERING CO.,
Engineers,
Savannah, Ga.; Bartow, Fla.

(PROPOSALS CONTINUED ON PAGES 170 AND 171.)

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